AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 18, NO. 10. WEEKLY. | NEW YORK, THURSDAY, MARCH 7, 1895. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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A New Bench Lathe.

We present herewith an engraving of a bench lathe, the design of which is the outcome of an order given by Mr. Herman Dock, a mechanical engineer of Philadelphia, to the Faneuil Watch Tool Co., of Boston, all necessary time and *carte blanche* being given to construct the best possible lathe, which was designed by Mr. Edward Rivett, manager of the above-named company.

The regular head and tail stock of the "No. 4 Rivett lathe" are used, but the bed is made deeper and longer to admit of the rack, screw and feed rod.

The carriage is placed on the side of the bed instead of on top, and is thus not so much exposed to chips and dirt, and can also be run past the tail stock out of the way when desired; as, for instance, when the slide rest is removed from the carriage and clamped directly to the bed, for use in that way, which can be readily done.

The other special features of this lathe consist of the improved slide rest (which was fully illustrated and described in our issue of July 28, 1892), a friction clutch on the carriage and an automatic chuck closer by which the chucks, which are of the standard draw-chuck pattern, with a capacity to take work through the spindle from $\frac{1}{32}$ inch to $\frac{1}{2}$ inch diameter, can be closed or opened while the lathe is in motion. We give a longitudinal (rear view) section of head-stock spindle and bearings which shows the construction of this chuck-closing device. It is there seen to be a simple construction, consisting of a movable abutment for the draw tube instead of having it abut as usual directly upon the end of the spindle. The mechanism consists of a sliding collar moved by a lever, this collar operating two dogs or levers that press against a collar placed at the end of the spindle, and force the draw tube back. This arrangement, of course, leaves the hand wheel to be used in the ordinary manner when a chuck is first put in place or when for any reason it is preferable.

Both the live and tail stock spindles are made of tool steel hardened and ground, the former being $2\frac{1}{4}$ inches diameter and with bearings $2\frac{3}{8}$ inches long. The thrust is taken by the front bearing, and the endwise adjustment of the spindle is made there, a taper sleeve being provided for taking up wear in the rear bearing.

By this construction the trouble which comes from expansion and contraction of the spindle in such lathes is done away with.

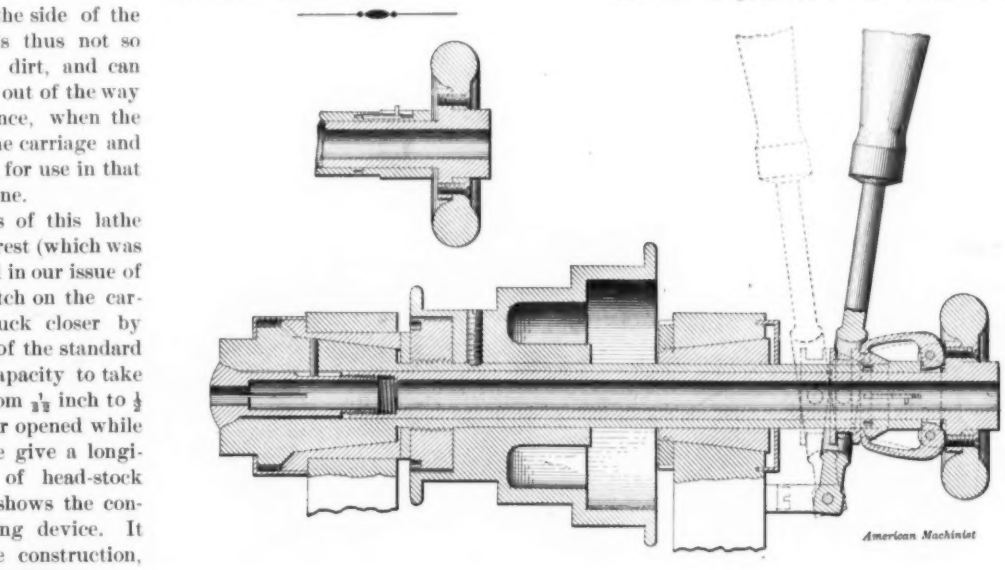
The lead screw can be made use of the full length of the lathe between centers (22 inches), and, with the gears supplied, cuts threads from 8 to 100 threads per inch.

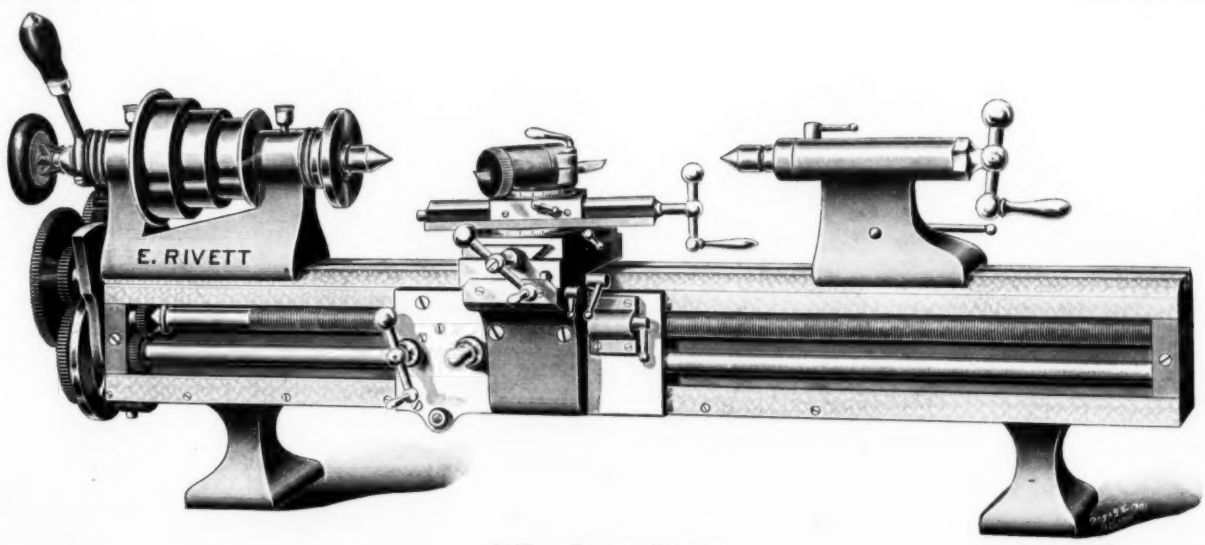
There is an automatic cross-feed which operates to the full capacity of the lathe—8 inches, and a follow rest by which delicate work can be turned the full length of the lathe

The rack and gears are of tool steel, and all important bearings are hardened and ground for the sake of securing initial and continued accuracy, and no pains have been spared to make the lathe as fine as such a tool can be made.

The slide rest furnished with this lathe is especially adapted for milling operations, and we give (page 182) full size engravings of a few milling cutters, the teeth of which were milled by its use.

We showed other forms in our issue of August 25, 1892. We are informed that the teeth were milled in the large angular cutter shown, in 27 minutes.





A NEW BENCH LATHE.

Free Expansion.

BY GEORGE I. ROCKWOOD.

There are two words much used in connection with the diagrams from a compound engine, upon which interest has long been focused. These are the words "drop" and "gap." Both words are of English origin, and are becoming quite elderly, having been handed about ever since investigations were first made into the action of steam in a Woolf compound engine; still it is curious that they are not written even to this day without the inclosing quotation marks, which testify to the fact that they are not words of well-defined and authorized meaning.

"Gap" is the older of the two words. It first meant the space found between the high-pressure and low-pressure diagrams when placed one over the other, both being of equal length. After being used long in this sense, it came also to signify the vertical distance between the boundary lines of this space at any point, or, in other words, the drop in pressure from the back pressure in the first cylinder to the forward pressure in the second cylinder, due to friction of the intermediate passages between the two cylinders. This, too, appears to have been one meaning of the word "drop."

Subsequently "drop" denoted the sudden fall in pressure of the steam as it is exhausted from the first cylinder into the clearance spaces of the second cylinder, where, also, the instantaneous liquefaction of some of the steam still further increased the amount of the fall. In the Gaskill pumping engine (a familiar example of a compound engine of the Woolf type) "drop" amounts to many pounds—say, 15 or 20—and is a nearly constant quantity, depending upon the amount of clearance, which is very small, and upon the condensation in the low-pressure cylinder. This is because there is neither cut-off in the second cylinder nor receiver volume. In this engine the principal factor in causing "drop" is initial cylinder condensation in the second cylinder. Indeed, for years it was supposed in general, that "drop" was unavoidable, because of the influence of condensation, and when diagrams were first produced from receiver compound engines, with no indication of a sudden fall in pressure at the "toe" of the high-pressure card, but rather with a sharp point there, it was thought to be due to the influence of the hot steam jacket in preventing condensation, and to very small clearance spaces, so that the designer of the engine took to himself considerable praise as one who had accomplished a great achievement. His cunning in reducing the clearance, cleverly applying the steam jacket, and, above all, in picking out just the right receiver volumes, was applauded.

In the receiver type of compound engine, however, there is no need of allowing "drop" in any such engine that ever was built, having variable cut-offs, if it is not wanted. Matters are differently arranged than in the Woolf engine. No matter how large the clearance volume or initial condensation may be in the second cylinder, within reasonable limits, and notwithstanding the receiver be relatively very large, "drop" as measured at the toe of the first cylinder diagram may be entirely eliminated, or may be made negative, or, on the other hand, may be exaggerated, by simply changing the point of cut-off in the second cylinder, changing nothing else. If, too, the point of cut-off is maintained quite late in the stroke in the second cylinder, and the volume of the receiver is varied from a volume relatively very small to one very large, this may also affect the amount of "drop" largely, say, from 2 pounds with the small receiver to 30 pounds when the large one is substituted. The general effect of increasing the volume of the receiver is to lower the initial pressure in the second cylinder, and the longer the cut-off in that cylinder is the more the initial pressure is lowered, corresponding in amount to the increase of "drop." Two agencies, therefore, besides initial cylinder condensation, act together to produce "drop"—lengthening the low pressure cut-off, and using a large intermediate receiver. Omit either, and the other cannot alone produce much of it, despite the fact that there may be large cylinder condensation. In a word, in any given compound receiver engine "drop" may be entirely eliminated by simply shortening the point of cut-off in the second or low-pressure cylinder. Certainly no cunning on the part of the designer is required to do this.

"Drop"—understood as the fall in pressure as measured at the toe of the high-pressure diagram—is a synonym for free expansion of the steam without doing work on the low-pressure piston. It is, however, by no means the only or the most important free expansion occurring in the engine, though one would not guess this fact from the agitation against "drop" set up by most professional theorizers who write books on the steam engine. "Free expansion,"

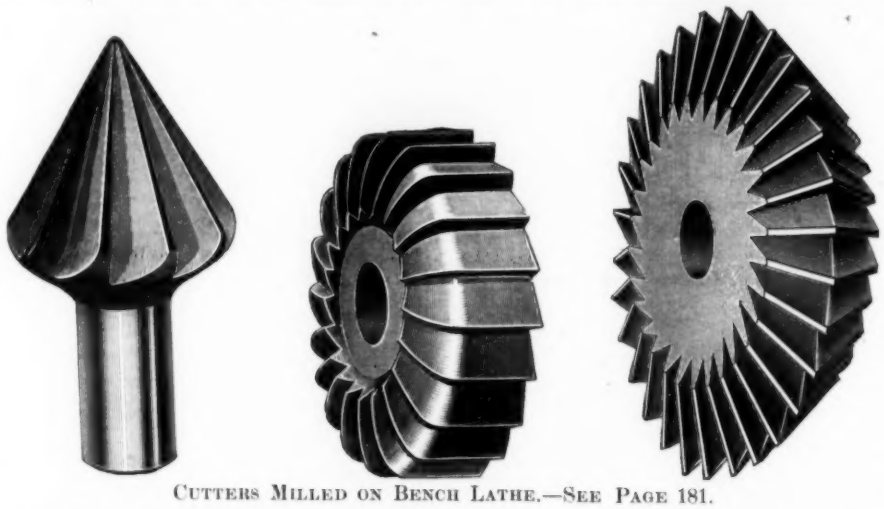
they say, "denotes great loss of potential energy. Therefore you are not up to date if you permit any free expansion about your engine," and apparently they are satisfied that there is no more loss to fear from free expansion if only "drop" is eliminated, forgetting that "drop" is the least of the causes of free expansion, and that in a receiver compound engine a certain measure of it—"drop"—may serve to minimize that greatest of free expansion losses, that by cylinder condensation, which is bound to occur to some extent in the second cylinder as a result of the range of temperatures to which its walls are subject.

To illustrate: Suppose the case of a receiver compound engine having a cylinder ratio of 1 : 3½, 5 per cent. clearances, and a receiver large enough to cause a nearly horizontal back pressure line in high-pressure diagram and steam admission line in low-pressure diagram. Good practice would allow a steam pressure of 110 pounds to 120 pounds at the boiler, and about 15 expansions. Suppose cut-off in second cylinder to be early enough to eliminate "drop" at "toe" of diagram from first cylinder. The minimum steam consumption under such conditions would be about 13½ pounds to 14 pounds per horse power per hour. Until recently this represented the very best practice possible with the compound engine.

Now, preserving the points of cut-off the same in each cylinder as before, suppose the boiler pressure to be increased to 160 pounds gauge, say, and decrease the diameter of the high-pressure cylinder to such a size as will give the same weight of steam to the receiver as before, simply exhausting at a terminal pressure higher than that in the receiver, what will be the economic result? The number of expansions will be doubled, roughly speaking; the amount of cylinder condensation in the smaller cylinder will be reduced, while that in the second cylinder remains practically unaffected; and the steam consumption per horse-power per hour will be decreased from the 13½ or 14 pounds to 11½ or 12 pounds, a saving of steam of about 15 per cent. But one of the very conditions of the change which produces this important saving is that there shall be considerable "drop." As much as 30 pounds, perhaps.

It may be asked, What would be the effect of carrying the higher steam pressure on the original engine, simply diminishing the volumes of *both* cylinders the same amount so as to keep the ratio 1 : 3½ as before the change, thus getting the advantages of the higher steam pressure, and at the same time avoiding "drop"? The answer is: What are the advantages unless the number of expansions is also increased? But this cannot be without cutting off earlier in the first cylinder, which consideration would bring us back to retaining the original cylinders to get the same work out of the engine as at first, in which case, too, the amount of cylinder condensation in the first cylinder would greatly exceed that in the second cylinder, and the loss thus obtained vitiate the gain from the increased number of expansions. That this is true is not simple conjecture. It has recently been proved in tests of a very large receiver compound engine—one of some 2,000 horse-power—running a rheostat load with a steam pressure of 160 pounds, and a ratio of 1 : 3, about. Under the most perfect conditions of operation this engine used up 13 pounds of steam per horse-power per hour.

Again, it may be urged that even if the ratio of cylinder volumes is made 1 : 7, as I propose, "drop" might be avoided still by having no receiver, excepting a very small one. Then by selecting its size just so as to produce in it by compression, after cut-off in second cylinder, a receiver pressure equal to terminal pressure in the first cylinder, "drop" might be entirely got rid of, thus diminishing the "gap" which "drop" produces in the combined diagram, and conducing still further to the economy of the engine. The answer again is, that "gap" will not be reduced much on account of compression in the receiver, and that such a course will not mitigate a particle the range in temperature in the first cylinder, while it will exaggerate the range in the second cylinder, simply because the lowest pressure—and, therefore, temperature—in the first cylinder, whether "drop" is used or avoided, is sure to be, friction of ports neglected, just that at cut-off in the second cylinder, whereas if "drop" to this cut-off pressure occurs at the end of the high-pressure piston's stroke, instead of in the middle of it as when there is no "drop," the initial pressure in second cylinder will also be reduced to the full extent of the "drop," and thus greatly mitigate the cylinder condensation in second cylinder, besides greatly reducing the force of the blow struck the low-pressure piston by the entering steam. This last pressure 20 or 25 pounds at least lower than the terminal pressure in the first cylinder.



Cutters Milled on Bench Lathe.—See Page 181.

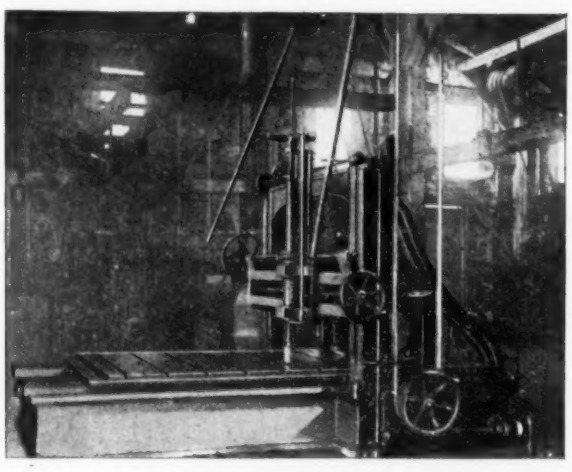


Fig. 112.

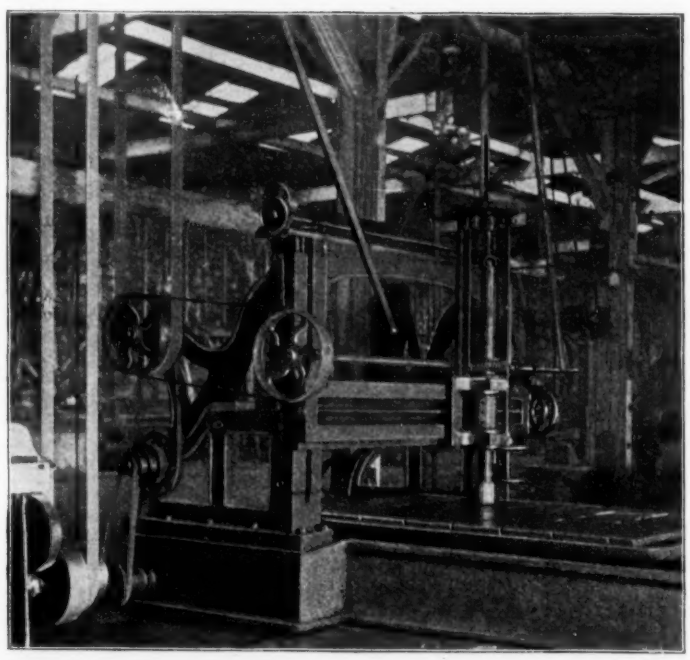


Fig. 113.

Machine Shop Milling.

is a feature of much practical importance in the quiet running of the low-pressure side of the engine.

A practical advantage of much importance to engines running generators, rolling mills, or any greatly variable load, is that the "drop" at normal loads makes it possible to run at very light loads indeed without doing negative work on the piston of the first cylinder. Of the whole question of "drop," and the consuming desire apparent on almost every hand, to abate it at whatever cost, it may be said, in the language of the Proverbs, ". . . . there is that withholdeth more than is meet, but it tendeth to poverty." The practical fact seems to be that a compound engine designed to do the utmost work possible with a pound of steam will do it when working with a receiver

Machine Shop Milling Practice—XX.

By Horace L. Arnold.

The Brooks milling machine, to which reference has been made in these papers, is in the general form of a planer, and has seven mill-carrying spindles, two of which are horizontal, mounted in head stocks arranged to slide vertically on the front faces of the planer uprights; of the other five milling spindles, all vertical, three are mounted on the front side of the cross rail, and two on the rear side of the same, all in horizontally sliding head stocks. All of the mills are 20 inches diameter, or, rather, all of the spindles are provided with mills 20 inches diameter, and are also fitted to take shank mills as well as those screwed on the spindle noses. The five mills on the cross rail, three in front and two in the rear, thus cover 100 inches, which is the extreme width of the cut. All of these spindle heads have short spindle adjustments independent of the long travels of their sliding head stocks. I am not able to give the vertical adjustment of the cross rail, but think it is not less than 60 inches, and it may be 72 inches. I have seen the machine more than once, but as I was promised photographs and blue prints for this series of papers, I made no sketches and took no notes. Now, however, the Potter Press Company decline to give full particulars, and I am therefore forced to pass this notable departure from all recognized types of milling machines with only the most general description. The five mills on the cross rail are all driven by one worm shaft, on top, which passes to the rear of the three front mill spindles, and in front of the two rear mill spindles. I am not sure about the drive of the horizontal spindles on the vertical faces of the uprights, but believe they are driven by spur gearing from the same horizontal shaft which carries the first pinion of the work table drive; perhaps, however, they are worm driven from splined shafts geared to the horizontal prime mover shaft under the work table. The travel of the work table is 20 feet, thus making the capacity 100 inches by 60 inches, or 72 inches by 240 inches.

When designing this tool, Mr. Brooks, as he informed me, was not quite sure of the practical value of milling in such large dimensions, and he therefore made this tool not only a convenient milling machine, but also a complete planer with five tool boxes, one on each upright and three on the cross rail. Those planer tool boxes have either never been used or had not been used for years, and may never be used again, Mr. Brooks informed me. The 20-inch mills used on this machine have, of course, inserted teeth, some of square and some of triangular section. The teeth of all were very light and weak, far below the present practice in strength, and the feeds used on this largest of milling machines are extremely slow, ¾-inch per minute being, if I can trust my memory, the common rate. The work done was mainly printing press frames; the machine is wide enough (100 inches) not only to take a cut over the side frames, but to take an entire assembled press frame and mill out the traveler troughs in position, thus insuring the absolute truth of all the trough bottoms with each other and the remainder of the framework.

The framing of the Brooks machine is about that of a good stiff planer of the same dimensions, which is undoubtedly ample for the end mill cuts which are, almost exclusively, used in the operations of this machine. Undoubtedly with suitable mills the work table feed of the Brooks machine could be raised to 10 or 15 times what is now used. And undoubtedly, again, if there was work enough in the Potter shops to crowd the capacity of the tool, the feed would be increased. As it is, with ¾-inch feed and using the five mills on the cross rail only, the machine can cover 300 square feet of surface per day.

The worm drive of the spindles is strong and good; I think steel worms and brass worm gears are used, and the whole machine is extremely creditable to Mr. Brooks, and was a bold step in advance of existing practice at the time when he put it on the drawing board. The idea of a double bank of end mills, part on the front side and part on the rear of the cross rail, is one I have not seen carried out elsewhere. It is not patented, and is certainly capable of extended application, and has the great advantage of materially reducing the total work table travel for a given length of mill cut. These two banks of 20-inch end mills may take up a lengthwise space of, say, 36 inches to 40 inches only, as against the 100 inches to be added to the length of milled surface to give the total work table travel needed to finish the given surface with an end mill 100 inches in diameter.

The details of feed and adjustment in the Brooks machine are very well carried out, and I can only express my regret that I am not allowed to reproduce them here in detail, as the example is extremely instructive, not only because it is, I believe, the largest milling machine, but because in it seven spindles are arranged with simple and convenient means for combined or independent handling. The Brooks machine is unique.

and will doubtless remain so, as the Potter Press Company will hardly duplicate it for their own use, and certainly will not build one for any other manufacturer; whether it will long remain the largest of milling machines is a question which the march of machine shop methods seems to answer in the negative; and it also seems that Brooks' idea of covering a wide surface by a double bank of mill spindles, has not found its last embodiment in the Brooks-Potter machine.

By the selection of the end mill in place of the side mill, Mr. Brooks at once avoided all possible difficulties in the feed table drive; these difficulties increase very rapidly with increased table width when side cutting mills are used. But a hundred inches width of mill cut with end mills does not entail a hard table drive. In the Brooks machine an ordinary planer table rack and pinion drive answers perfectly, and with suitably shaped mill teeth would answer for any rate of feed and depth of cut likely to be reached in ordinary metal surfacing practice without giving the slightest trouble. I think the date of the Brooks machine is about 1883–4.

A very interesting early, large milling machine is shown in Figs. 112 and 113, from photographs taken at the Green Point Iron Works shops, Brooklyn, from a machine, also unique, built by Pratt & Whitney in 1870, from designs by Mr. F. A. Pratt, for Steptoe & McFarlane, at that time safe manufacturers, Brooklyn, N. Y. The weight of this machine is 34,000 pounds; width of table 66 inches; 74 inches between uprights; table 115 inches over all, 48 inches clear between table and cross rail; cross rail 100 inches long by 16 inches deep by 6 inches extreme width. Spindle 4 inches diameter, with an internally threaded nose to take tool shanks 2¼ inches diameter, threaded 8 p. i., cross rail screw 2 inches diameter, 3 p. i., table feed screw 3 inches diameter, ¾ inch pitch.

Steptoe & McFarlane built "laminated iron and steel" safes. The doorway was as usual fitted in successive steps, and this machine was designed to take a stepped gang of mills, and mill the entire doorway, round corners and all, and also to mill the door to fit the safe. The machine was built by the day, and cost $6,000. The spindle is worm driven, and has an overhead end-adjusting screw, with a large gear, pinion and down-reaching hand adjusting shaft, for making vertical spindle adjustments, and a loose collar on the spindle between the two bearings of the spindle carrying saddle on the cross head; this loose collar is flanged, and put together with screws, so as to clamp on to the spindle and hold it rigidly in one vertical plane after adjustment, the collar ends abutting against the spindle journal boxes in the saddle. The feeds are all power driven in every direction, and are also double speeded to a fast and slow rate in all their changes. Steptoe & McFarlane went out of business, and the Green Point Iron Works bought this big milling machine, and have made great use of it as a general tool in their heavy machine shop at Green Point, L. I. The superintendent of the Green Point works told me he considered it the best paying tool he ever bought, and that it was so convenient and such a handy tool in spite of its size, that it was in constant requisition for small jobs as well as large, and was a steady every-day money saver; and that by its use he was enabled to machine a large class of work which could not be executed on any other tool in the shop.

I believe this 1870 machine of Mr. Pratt's was built quite a long time before Mr. Edmund P. Jorden, very lately deceased, designed the E. W. Bliss vertical spindle milling machines shown in Figs. 114 and 115. The Jorden machine is framed from the slotting machine idea, with the regular slotting machine work table, a circular worm-rotated table, mounted on a double cross slide, gibbed to the lower member of the frame, giving the work the same movements as the ordinary slotter gives, and the whole machine being almost a duplication of a French design of, I think, much earlier date. This machine has no claim to originality, but Mr. Jorden saw the great use he could make of such a tool, and forthwith built one of them and belted it up in the Bliss press shop, and in 1881 had ten of them in daily use. These tools were unfavorably regarded by the workmen at first, and one man after another was put on the new tool, as Mr. Jorden informed me, with the uniform result of broken tools and no work done. Mr. Jorden in this emergency went to one of the oldest and most reliable general workmen in the shop and asked him to take the new tool and make it work. The good workman declined the job, and when Mr. Jorden, who was one of the kindest and most considerate of superintendents, urged him to take the milling machine and make a success of it, he was met with the assertion that the machine was worthless, and could never be made to do anything by any man. Mr. Jorden thereupon told the man to take the tool and make it do good work and plenty of it—as much as Mr. Jorden thought it should do—or extend the sphere of his usefulness to some other establishment. The machine worked immediately to the satisfaction of all concerned, and is capable of finishing more small press frames than any other single-tool machine in a given time, I think. I am sorry that I cannot show the Bliss milling machine at work on a press frame in their own shops, but this is impossible for reasons which I need not mention.

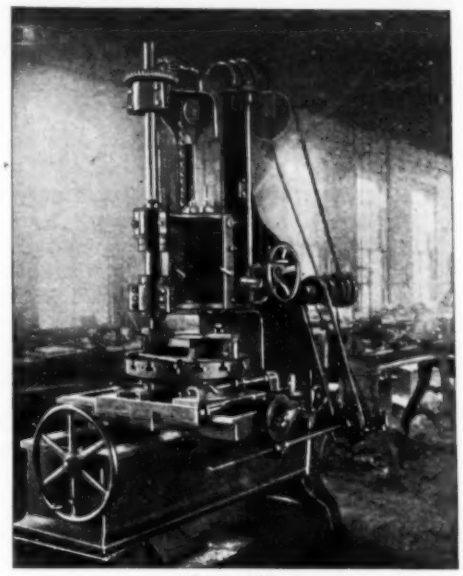


Fig. 114.

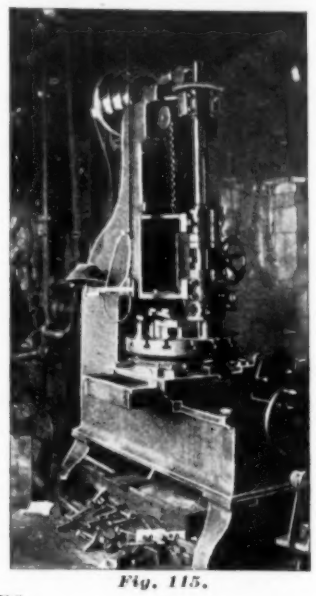


Fig. 115.

Machine Shop Milling.

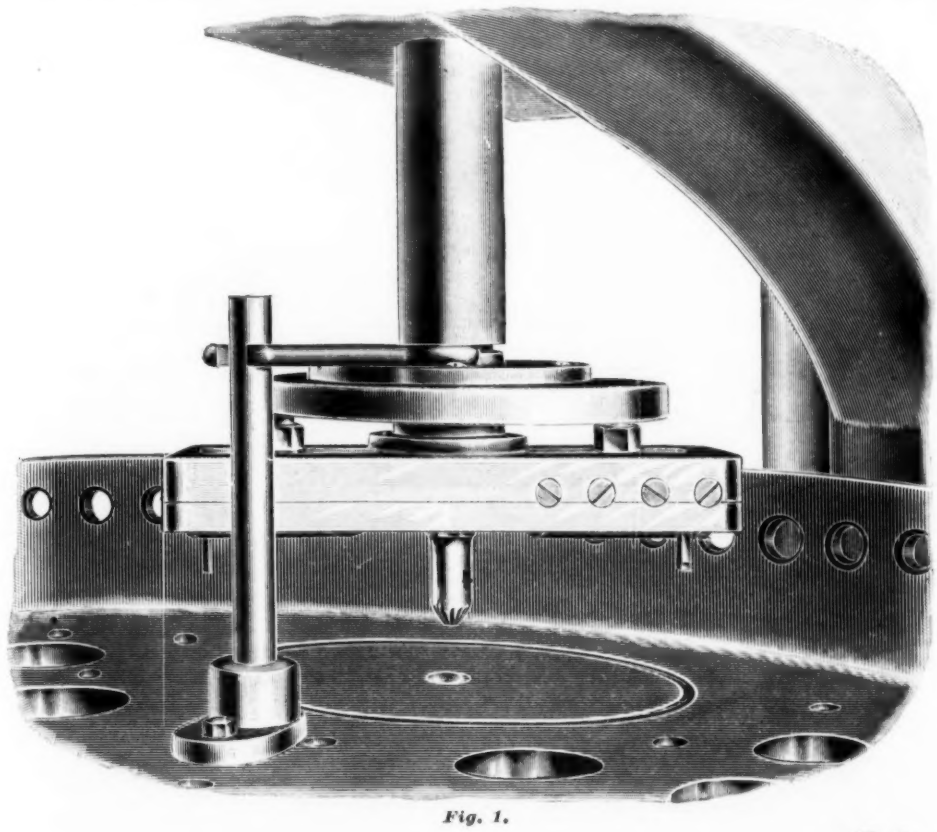


Fig. 1.

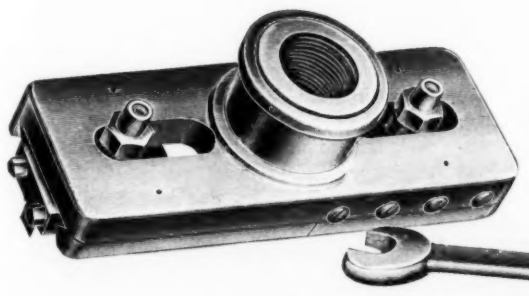


Fig. 2.

Fig. 4.

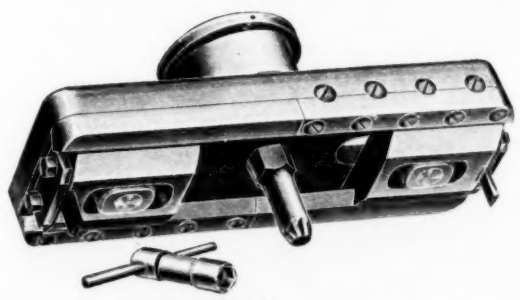


Fig. 3.

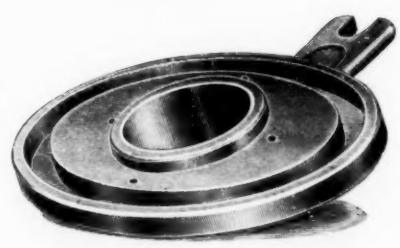


Fig. 5.

Tool for Cutting Manholes.

The photographs from which Figs. 114 and 115 were made were taken in the shop of Mr. Chas. Leffler & Co., manufacturers of presses, dies and tools, at 10–16 Division street, Brooklyn. At the Leffler shop, the Bliss milling machines were working on can tools, and doing die sinking jobs only, consequently the milling machines are not shown to advantage so far as quantity of work as compared with the planer is concerned. At one time I saw Mr. Jorden often, and he frequently said to me that he could get at least six times as much press frame finishing from 10 hours of a man's time with one of these simple cheap tools, as he could if the man was using planers, and that the work was fully equal to any planer work he could get his men to do. Examples of the use of these machines which I saw at that time, and notes I took of the time required made me believe Mr. Jorden's estimate of saving was well within the facts of the case. Since Mr. Jorden's time, the Bliss milling machines have been very much increased in weight, and are, so far as output is concerned, favorable examples of that type, and are thoroughly capable of use in ordinary machine shop work, where pieces of different shapes are to be finished and changes are frequent.

With this twentieth paper I close this series of articles, already extended far beyond the original intention. I am aware that what has been given does not cover the subject. There are fine milling machines built by a number of other makers—Bement, Miles & Co., Newton, Cincinnati Milling Machine Co., Kempsmith Machine Co., Beaman & Smith, Pedrick & Ayer Co., and others, that have had no mention; but the articles might be continued indefinitely and yet not completely cover the subject, and an indefinite continuance does not seem advisable.

I know that it is the intention of the American Machinist to keep its readers informed on this important subject, and I hope myself to contribute to this end as opportunity offers.

Tool for Cutting Manholes.

We present on this page engravings of a tool designed especially for cutting out manholes in boiler heads, one of these engravings (Fig. 1) being a reproduction of a photograph of the tool at work in the Bigelow Boiler Works at New Haven, the others showing it taken apart to make its construction clear. The tool is designed to be used in an ordinary drill press, and consists of a principal member shown at Figs. 2 and 3, which is adapted to fit the spindle, and is fitted below with two sliding blocks which carry the cutters and are moved to and from the center as the tool revolves; this sliding motion being imparted by means of a guiding groove formed in the lower face of the plate, Figs. 4 and 5, which groove is engaged by the rollers which are placed upon studs inserted in the sliding blocks, as shown in Fig. 2, an adjustment being provided here, as shown in Fig. 3, by which the size of hole cut can be governed and the cutters made to follow each other accurately.

It will be understood that in use all parts of the tool revolve except the cam plate,

Figs. 3 and 4, which is held by means of the forked arm shown, and may be engaged by a stud attached to the work, as shown, or to some stationary part of the drill press. As usually made, the tool will cut holes from 10 inches by 14 inches to 12 inches by 16 inches, and of course the cam plate is readily changed to produce holes having other proportions if desired. The guide pin in the center screws into place, and is readily removed or changed. All parts of the tool are made with special reference to resisting wear, and it has been used in practical boiler work sufficiently to demonstrate its practical value, the tool cutting, in the boiler shop mentioned above, a hole through ⅝-inch plate in from 30 to 40 minutes that would require from six to eight hours by the method pursued in many establishments. The tool is also used with good success in facing flanged manholes. It is made by the Geometric Drill Co., 698 Chapel street, New Haven, Conn., and is also adapted (in modified form) to drilling or boring many other forms of holes, such as square, hexagonal, etc.

A Heavy Milling Machine.

We present herewith an illustration of a milling machine specially designed for heavy work, either in manufacturing operations where the same cut is to be repeated a number of times, or in machine shop milling where the work is similar to that done by a planer, and stiffness and durability, with ease and convenience of handling, have been especially considered in the design. The head with spindle and attached parts has a vertical adjustment on an upright by means of screws and hand wheel and the head is securely clamped when machine is in operation. The foot block is similarly adjusted and clamped. The upright with spindle heads has also a screw adjustment to and from the table. The table is 5 feet long, but can be made any length to order. It is 14½ inches wide, and is driven by a large worm engaging with a rack screwed to its under side. The worm shaft has an adjustable bushing for taking up backlash, and the worm is provided with ball-bearing collars on both ends for taking the thrust.

The table has a power quick return by means of an independent belt; has tight and loose pulleys, and belt is shipped from the working side of the machine. It has power feed and knock off in either direction, also the usual hand-feed mechanism.

The front bearing of spindle is 3¼ inches diameter by 7½ inches long, with tool steel hardened and ground thrust collars and bronze boxes. Vertical adjustment of spindle is 2½ to 11 inches above the table. Horizontal adjustment is 4¾ to 13¼ inches from end of spindle to center of table; greatest distance between end of spindle and foot block, 25 inches; least distance, 9½ inches. The driving cone has four steps, 10½ to 21 inches diameter, for a 2½-inch belt, and is geared to spindle in a ratio of 9½ to 1. There is a reverse countershaft so that the spindle may be run in either direction. It is made in four sizes up to 35,000 pounds weight, by the Pratt & Whitney Co., Hartford, Conn.

A New Element.

Argon, as the lately discovered constituent of the atmosphere has been named, is attracting great attention by reason of its peculiar properties.

Having a density of 19.9, or very slightly greater than nitrogen—its critical temperature is — 121° C., its boiling point is — 187° C., and its freezing temperature is — 189.6° C. Up to date it has been found impossible to force it to combine chemically with any other element, and the ratio of its specific heats being closely 1.66, mathematicians believe that it consumes no energy in intermolecular work, and that the atoms of the gas exert no action whatever on each other.

It is announced that a number of good-sized orders have been given lately for new rolling stock for railroads, and that other orders are bound to follow for stock that is worn out and must be replaced in order to keep the roads in operation. The force of men employed at the Wagner shops in Buffalo has been recently increased. The Pennsylvania road has increased its force in the shops at Altoona, and it is reported that the Erie will order 4,000 tons of steel rails.

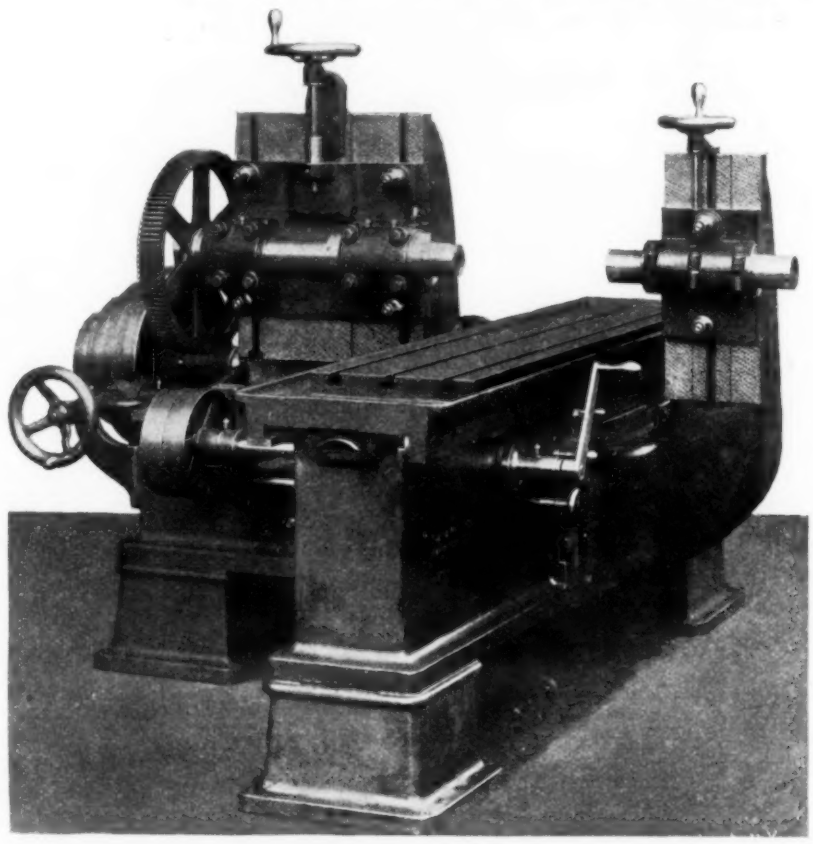
The railroads exert, directly and indirectly, a much stronger influence upon manufacturing than any other one interest, and it seems certain that before they must perforce buy supplies in much larger quantities than they have been doing for some time past.

Some Cincinnati Shop Notes

Probably not many of those who attended the convention of manufacturers in Cincinnati, and tried to keep the run of what was going on at the meetings, and in the intervals between the meetings, found much leisure time in which to visit shops and friends within them, yet I managed to go about a little, and amongst other places visited the new shops of

THE CINCINNATI MILLING MACHINE COMPANY.

These shops are in strong contrast to their old quarters down in the manufacturing district near the river, and must enable



A Heavy Milling Machine.

better work to be done much more economically. Amongst the other advantages which they enjoy is that they are sufficiently far to the northwest to escape in some degree the universal pall of black coal smoke which pervades and overhangs the city, growing thicker and darker as manufacturing interests extend and multiply. This relatively clear atmosphere permits the sunlight to pass through it. And after that it is only a matter of windows—and the windows are there.

Mr. Holz has taken with him to the new shop the excellent methods pursued in the old, which have been described in these columns, and the time of my visit was mostly taken up in examining some specimens of a new line of milling machines which they are developing, and in watching an expert put their improved universal cutter and tool grinder through its paces. This machine was fully illustrated and described in our issues of March 15 and March 22, 1894, and needs no further description, though it is proper to say, perhaps, that few mechanics will be apt to realize fully the convenience and the capacity of such a machine until they see it handled as I did, by an expert familiar with it and having entire confidence in it. Using a cup wheel it was demonstrated to be surprisingly efficient as a surface grinder, and it also grinds cylindrical and taper work upon centers in a manner and at a rate which I confess I was not prepared to see; these functions, added to its ability to do cutter grinding of all kinds, making of it a machine that ought to do (as in fact it is doing) much to educate mechanics both of this and foreign countries to the value and importance of properly ground milling cutters, and of other work finished by grinding after hardening.

Of course, I do not mean by this that the machine will take the place of regular surface grinders and universal grinders, but it will get into many places where they would never go, and its influence in any shop will inevitably be good. This much should be said in simple justice to what is one of the newer and perhaps least appreciated machine tools.

As to the new milling machine referred to, that will probably form the subject of an illustrated article before long, and need not therefore be further referred to now.

At the shops of

THE LANE & BODLEY COMPANY

I found much to interest me. They have been developing the habit of doing new things in new ways, and amongst other somewhat unusual things are building in the same shops, though in separate departments, so far as the machine shop is concerned, two classes of engines which represent the extremes in engine construction; one being the plainest kind of a plain slide valve engine, the other an elaborate, refined and handsome Corliss. The first named engine was aptly described by Mr. Lane as "a mule." It is an engine reduced to its simplest elements—self-contained, *i. e.*, outboard bearing constituting part of the bed—overhung cylinder, and with the fewest possible chances for adjustment of any of its parts. The lagging is cast on the cylinder, *i. e.*, the walls are simply made double with an air space between, and the front cylinder head is cast solid with the cylinder, so that the tap bolts which secure it to the bed have no steam joint to maintain the integrity of, but have only to hold the cylinder in place.

The guides are bored, and the crosshead has a wedge on the lower side only, the upper side running directly upon the upper guide, cast-iron to cast-iron, with generous bearing surfaces. When this crosshead is to be adjusted a nut on the piston rod is slacked, and the crosshead can then be adjusted independently, because the piston rod is in a slotted hole in the crosshead; that is to say, the hole is slotted vertically, allowing the crosshead to be shifted upwards to compensate for wear and yet keep the piston rod in its proper place, this being again secured by simply tightening the nut. The eccentric strap is babbitted and cannot be adjusted; there is no outside adjustment for the valve, except by shifting the eccentric, and the only other adjustment of any kind for the valve involves taking off the steam chest cover. The guide for the valve stem is twice as large as usual—formed by taking a large square bar and drawing it down to form the stem—and runs in babbitt with no means of adjustment. No part of the engine is tooled or finished except where it is absolutely necessary, and yet the machine looks well, because it has the appearance of having been made so "on purpose," and is made in what an old mechanic—friend of my youth—would have called a "rough and workman-like manner." It certainly looks well adapted to the purpose for which it is intended—saw-mill, brick-yard and similar work, where history tells us that "when the cylinder gets cut, the negro engineer bores it out with a grate bar," and "oil gives out and water is used till a hog is killed."

Not the least remarkable feature about the engine is the fact that it has to be sold at about four cents a pound.

Of course, an engine sold at four cents a pound must not cost five cents a pound to build, and a typical machine shop job on this engine is that of boring and facing the cylinder.

As previously stated, the forward cylinder head is cast solid with the cylinder, and the counterbore at this end is not a counterbore at all, strictly speaking, but is simply cast or cored larger than the finished size, so that when the boring tool, starting at the other end, comes to this enlargement the cut is finished. First the cylinder is fixed upon a boring-mill table, and the hole for stuffing box and piston rod bored, while at the same time this end of the cylinder is faced off outside for a true bearing on the bed. Then it is turned up the other way, placed over a stud which fits the stuffing-box hole and upon a true ring, clamped and bored by a plain Mushet tool, which is made double-ended and equal in length to the bore of the cylinder. A roughing and a finishing cut are taken with separate tools, and the whole job on a 10-inch by 16-inch cylinder has been done in 3 hours 25 minutes; a 51-inch Niles boring mill being the tool used.

Those who visited Chicago in 1893 will remember that some of the Lane & Bodley Corliss engines shown there exhibited certain rather radical departures from conventional designs; amongst these innovations being the abandonment of the square corners at the ends of the cylinder and, instead of these, making an equal thickness of metal all around the valve chambers—which means, of course, boldly rounded corners instead of square ones, and round flanges at the bottom of the valve stem hoods instead of square bases. This style of engine was illustrated in our issue of January 25, 1894, and few, if any, are now built the old style in this shop. When one gets a little accustomed to the new form he is impressed with the idea that if Geo. H. Corliss had not happened to make his engines with square blocks at the four corners of the cylinders no one would now think of making them so, but instead would, after striking the circles for the valve seats, simply open his compasses and strike a larger circle, giving the proper and a uniform thickness of metal about it. This seems the natural thing to do, and it looks right.

The bed of this engine is also a new departure, being a true box section—square with slightly rounded corners and without an opening of any kind except at the ends; one of these being concealed, of course, by the main bearing; the pedestal being cast solid with the rest of the bed. There is no doubt, of course, that this bed is functionally right, and it certainly looks exceptionally neat.

There are but three principal castings

about the engine—the cylinder, the bed and the fly wheel. Making the bed in this way may seem a simple matter, and it really is so I suppose, and yet engine beds of similar appearance, made in Europe, usually have openings along their lower sides, or what amount to openings so far as weakening effects are concerned, *i. e.*, openings that have been stopped with sheet metal and painted over; in fact, there is some ground for suspecting that some of the castings shown by foreign founders at recent exhibitions, and which puzzled our own foundrymen to know how they had been produced, had been doctored considerably by those wicked foreigners even to the extent of machining and filing their entire outside surfaces before painting them in some cases.

Returning to the engine, amongst the details noticed were that crank pins are simply forced or shrunk in and secured in no other way, either by nuts, riveting or keys. When I inquired about this departure from usual practice, Mr. Lane said it was their belief that if a pin fitted properly throughout the entire length of the fitted portion, it would hold as well without these extra means of securing it as with them, and that if it did not fit properly no such devices could make a good job of it. They had, therefore, adopted the plan of measuring crank pin holes at each end and in the middle, and both ways, *i. e.*, vertically and horizontally, at each point. The pins were gauged in the same way, and they were thus sure that the predetermined allowance for pressing or shrinking was made not merely at one point, but practically at all points of the fit, and they had found the plan to work well. A careful record is at present being kept of every such fit—the exact measurement at every point of hole and pin, together with the exact force required to press the pin to place, and it is the intention eventually, when sufficient data have been secured, to mark on the drawings the exact size to which the work is to be bored and turned, instead of marking both hole and pin $2\frac{1}{16}$ inches, for instance, and then depending upon someone's knowing that $2\frac{1}{16}$ inches for the hole means $2\frac{1}{8}$ inches, but for the pin something else more than $2\frac{1}{16}$ inches, the amount of excess being a mere tradition of the shop, or a piece of folk lore; in other words, depending upon someone's knowing that the figures given are not correct, and that the work must be made to some other figures, and then also knowing what those other figures are.

Tool builders are in the habit of making lathes of all sizes the same hight from floor to centers; and these Corliss engines, or at least all sizes up to 32-inch cylinders (which includes nine-tenths of the shop's production) are made 27 inches from floor line to center line. This is found to be very handy when it comes to making up cross and tandem compounds, because any desired combination can be made—any cylinder can be put on any bed or any two cylinders can be put together tandem without a break in the floor line; and not only this, but the special tools for boring and finishing cylinders are very materially reduced in number and cost as compared with what they would be if the hights of center lines varied for the different sizes of cylinders.

Milling machines are used considerably, and will probably be used still more. Some pretty large cutters are employed in milling through the Corliss valves where the stems fit into them, and a number of milling cuts are made on the governors which are of the high-speed type, and are made in lots of 100 each, being so designed that one size of governor answers for a wide range of sizes of engines right or left hand. A thing noticed in connection with this governor strongly appealed to my sense of the eternal fitness of things, and that is that the pulley attached to it is simply a neat, straight-armed standard pulley, such as are made and used by the thousand, and can be had of any first-class maker of transmission apparatus. This seems a matter almost too small to be talked about, but I have seen so many governors on engines of this class driven by special, webbed and finished-all-over pulleys not looking half so neat and sensible, yet

A Floor Hanger.

costing four times as much to accomplish precisely the same purpose, that this seems to me to be one of the typical features about the engine that is worth mentioning. And if the speed of the engine is to be changed, any standard pulley of the required size will go in the same place, and will look as though it were designed to go there.

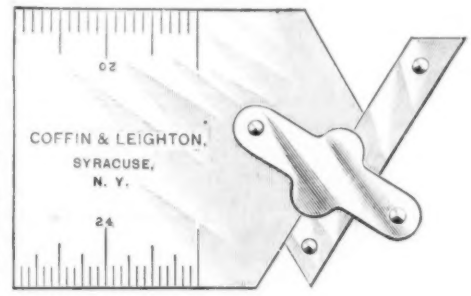
The system of pattern accounting in use here is certainly much more simple than most of them, and seems to afford a complete record and a means of quickly finding any pattern or set of patterns.

To begin with, every pattern is numbered consecutively as it is made, and there is nothing to designate it except its number—no symbols—nothing but the number. In a number of books kept in the drafting room a record of these patterns is kept, a page of a book being devoted to each pattern. The pages are numbered consecutively throughout the entire series of books, and on the back of each book is marked the number of the first and last pages in that book.

Each page is devoted to the pattern of corresponding number and in a suitable blank printed at the top is entered all the particulars needful to know regarding that pattern—the engine or other machine to which it belongs, the name of the piece or part, approximate size, location of pattern in the pattern storage-house (section and shelf), number of separate pieces belonging to the pattern and the number of special core boxes if any. The lower two-thirds of the page is left blank, and here may be a sketch showing changes, or any remarks may be entered concerning that pattern.

In another book all patterns are entered and indexed alphabetically by all the names that can reasonably be applied to them, and their numbers noted. Thus any pattern can be identified or found either by name or number; the system is perfectly elastic, and it is very simple. The complete scheme contemplates also a book for each foreman, small enough to be carried in the pocket and with numbers and names entered in such a way as to make identification of any pattern or casting easy.

In the accompanying view of a floor hanger, for instance, the pattern number is seen at the right near the base, and from what has been said, anyone familiar with such matters may easily imagine what the pattern record would be for that job. Incidentally it may be proper to call attention to the fact that this floor hanger exhibits some very creditable points of design. To begin with, it is handsome, and it is functional—gives extreme and perhaps nearly the greatest practically possible rigidity for its weight, and is especially convenient when the half boxes are to be removed from the shaft. By removing two bolts the upper part of the hanger is taken off, and the upper half of the box can then also be lifted off. The lower adjusting screw is then run down away from the box, and one of the lateral adjusting screws run back, when the remaining half box can be turned up over the shaft, and removed. It will be noticed that when the box is to be put back one of the lateral screws that has not been moved, and the upper adjusting screw that goes back to its original position when the upper part of the hanger is again bolted in place, locate the box precisely as it was before it was taken out, and it is necessary



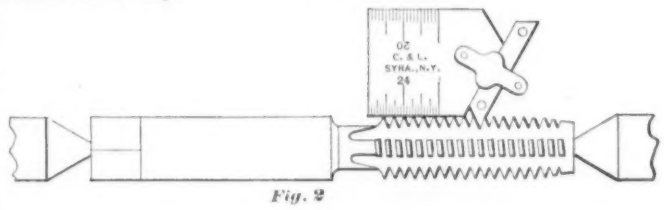


Fig. 2

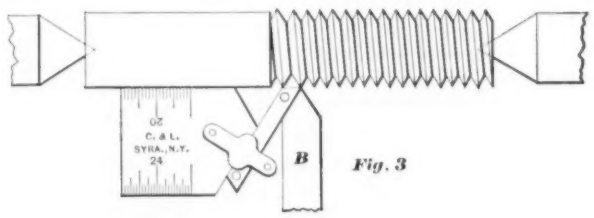


Fig. 3

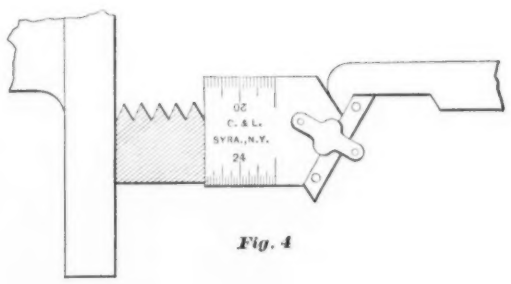


Fig. 4

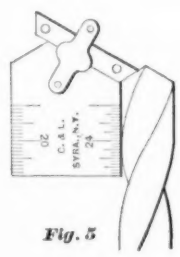


Fig. 5

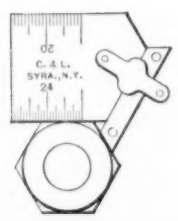


Fig. 6

American Machinist

A New Thread and Center Gauge.

only to run the others up to a bearing. This feature is important at times when things are hot and time is short.

F. J. M.

A New Thread Gauge.

Every machinist who has cut many inside threads on the lathe has experienced the difficulty arising from the fact that the V-notch in the ordinary thread gauge is too large for the smaller inside threading tools. A correspondent of ours once recommended filing off the side of the gauge at one side of the small notch, but this, of course, is objectionable, because it spoils the gauge for larger tools and for setting outside threading tools.

We illustrate herewith a new gauge which has an adjustable notch, *i. e.*, a notch, or rather two notches, which can be made as small or as large as may be desired, and in arranging for this several other good features are secured, as shown by our illustrations.

Fig. 1 shows the tool full size. The right-hand end is ground at such angles that the movable blade when held firmly against these edges by the pivoted link forms the required angles, as shown. The link referred to has only a very slight movement either way, and binds the blade securely when pressed in either direction. By this construction all surfaces to be ground in making the gauge are outside surfaces that can be ground by plain wheels, accuracy depending upon the fixtures in which the parts are held when being ground.

Fig. 2 shows the gauge being used to test the threads of a tap; Fig. 3 setting an outside threading tool in the lathe (it is here evident that by turning the gauge over both sides of the tool would be gauged); Fig. 4 shows it as used for setting an inside threading tool, a portion of the lathe face plate, and part section of a ring being threaded as shown. Figs. 5 and 6 show the tool used as a drill-grinding gauge and as a nut gauge. The gauge is made of hard steel, is graduated on both sides—four different scales, and the entire perimeter is accurately ground.

Notes on Jet Condensers and Air Pumps.

By A. Bollinckx.

In arranging for jet condensation with engines of ordinary dimensions, it is necessary to use considerable caution, as by reason of the short time required to overflow there is danger of water backing up into the cylinder at stopping, or slowing down, and in such a case a breakdown is likely to occur on again starting ahead.

It is not always convenient to arrange the injection valve within such range of the throttle that it can be at once closed on slacking the speed, and even where it is so placed it is much more satisfactory to provide against flooding in a way that allows the valve to remain at normal opening, as the injection requires some attention to properly readjust after being once changed.

The best all around method of accomplishing the desired result is to place a float in the condenser, an air cock being operated by the lever when water rises above a safety point. This arrangement relieves the engineer of all anxiety, his only responsibility being to see that the apparatus is maintained in proper repair and working condition.

If a float cannot be used, a simple air cock, worked from near the engine throttle, will be found the next best device, as by a turn of the hand wheel at slowing down air enters the condenser and holds the condensation water back without necessitating the closing of the injection valve.

The class of engine known as "high-pressure condensing," in which there is no vacuum under normal conditions—the exhaust steam being simply discharged into a tank of feed water for the purpose of heating the latter—should be supplied with a float and air cock, as on stopping the steam in cylinder on exhaust side of piston is liable to condense, and in that case, unless proper provision has been made to prevent it, the feed water in tank will block up in the engine and possibly fracture the cylinder head when steam is again turned on.

The use of a float in either type of engine

prevents flooding due to the pumps failing to function properly.

Air pump valves are often found broken, if of metal, or torn, if of the soft rubber so often used, and in such cases the pump is likely to fail to clear the condenser.

Foreign substances, waste, chips, etc., are very often jammed in the passages, and where the valves open downward—hanging—held to their seats by springs, the stud nuts are liable to work loose, letting the valves fall into the chamber below. For this reason pumps should be designed with lifting valves only, in which type the springs can be much lighter, and the seating is far more satisfactory than where both the weight of valve and column of water must be balanced by the stiffness of a wire coil.

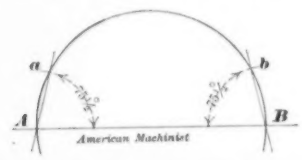
Brussels, Belgium.

LETTERS FROM PRACTICAL MEN.

The Proposed New Standard Screw Thread.

Editor American Machinist:

In the article in your issue of February 14th, on the "Proposed New Standard Screw Thread," I think we as users of machine tools can all agree with Mr. H. J. Hendey, as to the desirability of a standard size for lathe centers and spindle noses for face plates. Of course, those of us who are compelled to keep on with the old tools will receive no direct benefits, but that is no reason why the best form at present known should not be adopted for all regular work.



I am however well aware that to keep lathe center holes near enough alike to insure interchange for work made during a term of years, and by different shops, will require more care than might at first seem necessary.

Regarding the "wild cat measurement" of 29 degrees, as Mr. Smith calls the angle for sides of rack teeth and worm threads, the Brown & Sharpe Mfg. Co., in their "Treatise on Gearing," page 14, Fig. 8, show a very simple and convenient way of obtaining this angle, and while it is not likely to be so universally known as the way to obtain an angle of 30 degrees, yet I hardly think that should weigh heavily against this angle, inasmuch as it is already established for its present uses at least. The production of this angle of 29 degrees, as given in the book above noted, may be thus described: Upon a straight line *A B* with any radius describe a semi-circle; from the extremities of this semi-circle with *one half its radius* describe arcs cutting the semi-circle in points *a b*. Straight lines drawn through these points of intersection *a b* and the extremities of semi-circle *A B* will form angles of 75½ degrees with the straight line *A B*.

About ten years ago, in cutting some very coarse pitch square thread screws (2¼ inches diameter, 2 inches pitch, quadruple thread), my attention was directed to the fact that this style of thread as ordinarily made does not fit the nut if the nut is cut in the lathe in the ordinary way, but it bears only at its extreme corner until by use this corner is worn off, or mashed down to a broader bearing.

The cause of this trouble is that the cross-section of our screw thread *is not square*, but is in reality a trapezoid attached by the shorter of its parallel sides, or, in other words, of a wedge shape attached by its narrow end. The groove forming the thread in the nut *is square* in cross-section, however, and obviously the fit is as stated. Of course, the easiest way and the best way quite likely to correct this fault is to shave the nuts with an accurate tap.

The cutting under of the sides of the square screw thread, for such it really is, increases with the increase of the angle of the spiral, and so is most noticeable in screws of relatively coarse pitch.

C. S. Beach.

The Camera in the Machine Shop.

Editor American Machinist:

It is surprising how few drawing rooms in machine shops are provided with a camera. There is nothing that can be added to the shop that costs so little that will help so much in the sale of the products of the shop as a small camera. Nearly every shop that builds machinery has at times a tool or machine under construction out of the general line, and a small photo of it will in many cases help an intending purchaser to adapt his wants to some machine that the concern has patterns of.

Nearly every shop is at times putting in new tools, and has some old ones to dispose of. Some machines do not have name of maker on them, and it is hard to make an intending purchaser at a distance understand the exact build of the tool or machine for sale by a written description, but if a small photo or blue print can be sent, he knows at once the general appearance, and a short written specification enables him to decide if it will suit his wants.

A camera 4 inches by 5 inches, with complete negative and printing outfit, can be purchased for not to exceed $15, and will even in one sale of an antiquated tool or machine pay for itself.

In the sale of new tools even a blue print conveys to the purchaser a better idea than some of the poor wood cuts we see in even the latest catalogs, and a tool recently purchased by the writer from one of the leading tool manufacturers when it arrived looked very much different from the cut in the catalog.

Now a word in regard to taking photos in dark portions of the shop or at night. Place your camera at a suitable distance from the object, place a lighted candle or lamp on a central portion of the machine and focus on the light so it comes up sharp, cap your lens, place plate-holder in position, remove the light from the machine and use a flash light, uncapping the lens the proper length of time. Now the flash light is a very simple thing. Procure some magnesium powder, take a long stem tobacco pipe, wrap some cotton around the bowl so it will extend a little above top of bowl, place some of the magnesium powder in bowl, saturate the cotton with alcohol and light it when the pipe is quite warm, blow through the stem, which will force the powder into the flame, making a dazzling light, at same time uncap lens, and if the exposure is timed right and focus sharp you will have as fine a negative as you could wish. Of course, a little practice will help in producing fine pictures.

Angelica, N. Y. F. H. Jackson.

Some of the Difficulties of Running a Machine Shop.

Editor American Machinist:

Every week, for long years, the American Machinist has been taken out of its wrapper by me, and its pages enjoyed, and, from time to time, I have contrasted the apparent ease and comfort of editing a paper like yours with the trials and tribulations of running a machine shop.

Harper's Monthly is responsible for the general belief that the editor has an "easy chair," and, surely, you are not behind it in modern appliances.

A delightful week spent in your company proved to me that the cordial and even temper not only of yourself, but of all those connected with you, is not a mask assumed on the appearance of your friends, but a true characteristic, which seems to me should be the result of entire freedom from worry. It may be some little trouble to give everybody the best place in your paper for their "ads"; it may have cost you some thought to get so nicely going, and perhaps some trouble to make the men who always want the inside track, understand that there is none. But beyond selecting articles to print, and calling on your patrons, who are always glad to see you, there does not seem much for the editor to do except to acknowledge checks.

Now, look at us, Mr. Editor—at us who are M. E.s and run machine shops, and weep.

Look at the amount of figuring we do over jobs that we never get; think of our feelings when we discover that some other shop can do a job at 60 per cent. less than we can do (and make money), leaving us only the poor consolation of saying that "anyone is welcome to it at that price," and that "whoever takes it at any such price will get 'stuck.'"

Remember how we have to make a price on a thousand articles "just like the sample," on a spot cash basis, and then be asked to make up a sample "just a little larger here, and a little mite fuller there, etc.," payment to be made when the model is satisfactory.

Think of the terrible strain on us every week, when we are obliged to forego the fortunes thrown at us by the "Common Necessity Co.," who offer us the opportunity of making 1,000, payment to be made in stock of such employ, full paid and non-assessable, which will be worth a fortune as soon as goods can be had to fill orders, yet we are still obliged to scratch round for wages and next week's bills.

Think, again, of the absolute lack of judgment we have shown in buying the Bi-Jones lathes and the Smithson's planers, or the Sharpsmith's millers, when such superior tools could have been obtained of the speaker; saddest of all, picture to yourself a customer who is going to pay weekly, coming into your office with fire in his eye and no money in his pocket, wanting to know how you can get 354 hours out of one man's time in a week; who is surprised to know that six men were at work for a week; who cannot understand why you cannot get a blacksmith's helper to work for love, or why fire consumes fuel, and is astonished to hear that a draftsman's time is charged, or that the cost of material and labor together do not represent the cost of an article.

He wants to set your prices and regulate your business; he can get just as good work at Whitemiller's at half your prices; he thinks odd sizes of taps and screws grow on bushes; he does not believe there are any more good machinists to be found nowadays, anyhow.

(What would he think if he were charged for all this time that he has wasted!)

Consider the time we have to spend in trying to show that several gears do not gain power, and how we have to toil to make people see that no matter what shape is the hole made in the bottom of a quart pail, you cannot draw more than a quart out of it.

Again, think of the people who honor you with an order, and with drawings that show just what they do not want, and tell you to "use your judgment," and then kick like steers when your judgment contravenes their own; they know just what they want, but are unable to tell you what it is, until they see that what they ordered is *not* what they want.

Call to mind, Mr. Editor, the friend who sends "perfect working drawings," just covered with figures and directions, but never gives the total length of anything, but allows you to add up the lot of figures to get at it; who never marks the kind of material to be used in any part—unless it is beyond question that only one material can be used—who always calls steel castings cast-steel; who tells you to bore a hole when he means drill; who gives a lot of queer names to parts which mean nothing to you or to the patternmaker or to the foundrymen. He writes to you to make a little hole which is on the left of the little "dingus" in the left-hand corner of wheel No. 3 just twice as large, and gets mad when you follow his orders, because he finds that he meant four times as large, but knowing nothing about the areas of circles he got badly mixed.

Then, think of all the bulls you can make yourself!!

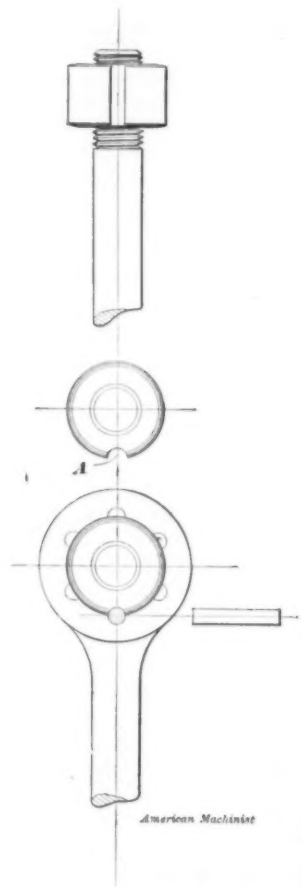
Since the above was written the writer has gained some inside information concerning the difficulties of running a trade paper, and he is now quite willing to stick to the machine business—and has come to the conclusion that perhaps it encounters as few ills as is to be hoped for—until the title of M. E. is exchanged for R. I. P.

W. D. Forbes.

Nuts for Fly Wheels and Foundation Bolts—A Hinged Caliper.

Editor American Machinist:

We have the pleasure to send you blue print of the nut we make use of to assemble our fly wheels, and for our foundation bolts.

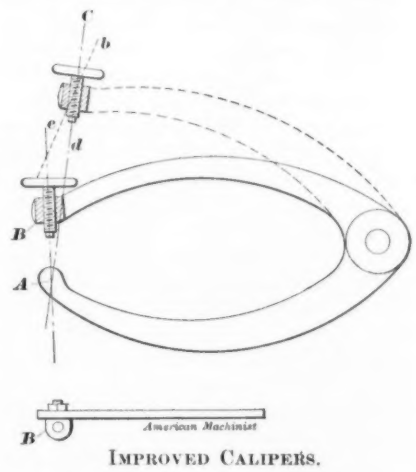


Fly-wheel Nuts.

It is a round nut with a groove. The wrench has six grooves, not more, and it is therefore sufficient to place a broach [key] between the wrench and the nut at the moment when the grooves meet for entraining the nut with the wrench. I am using this system for the last 10 years, and it is a device of my own which I invented after an accident that happened through tightening a foundation bolt, the open six-sided wrench having got open.

I therefore first thought to make the six-sided wrench closed, and after that was soon led to make it round, as shown.

Concerning the calipers, I am for the greater part of the opinion of "A Mechanic." I forward the plan of the calipers



Improved Calipers.

I devised, and which I have been, with success, using for long years. The workman can, with the greatest ease, detect one-fiftieth of a millimeter [about .0008 inch] between the gauge given and the piece he is finishing.

These calipers are especially useful for finishing pieces by means of emery wheels—grinding we are performing on Brown & Sharpe's and Landis Bros'. machine tools.

Concerning your paper, we are glad to state it renders us great service in showing us the most practical way of working, and

it has been most useful for our buying of American machine tools.

L'ADMINISTRATEUR DÉLÉGUÉ,
Brussels, Belgium. H. BOLLINCKX.

The Co-operative Contract System.

Editor American Machinist:

The current literature of the day relating to the labor question contains so much of a sensational character, and often, indeed, so distorts actual facts as to become a disturber of the peace. It is refreshing to meet with a treatment of this subject that is perfectly free from bias, and that tends to allay, rather than excite antagonism between the employer and the employe.

The "co-operative contract system" presented and explained by Mr. John Richards in the AMERICAN MACHINIST of November 15th is a happy effort in the right direction.

Not to trespass on your valuable space, or sin against the time and patience of your readers, I will endeavor to "boil down" a few thoughts I may have on this subject.

Just how far the system named by Mr. Richards, as employed in some parts of England, may be made available in the United States, is, of course, an open question.

There is comparatively little known, I think, of the different systems of compensating skilled labor now used in this country. Not that any special effort is made to keep such matters a secret, but while this great problem is being worked out it cannot be expected that men who are earnestly wrestling with the subject should be anxious to rush into print in making known their plans or experiments along this line.

There are evidently many reasons why no concerted action can be had between manufacturers looking to anything like uniform methods. In most of the smaller machine works, such I mean as employ from a dozen to fifty workmen, the clerical force is usually very limited, and too much *system* is considered inimical to prosperity; therefore the cost of anything they build is rarely ever known. The co-operative contract system would cut an awkward figure, I fancy, in such shops, but when once established would doubtless reveal some startling facts. They would find, perhaps, that many parts of their work could be supplied by other makers at a greatly reduced cost, and that in some cases an actual incongruity existed between different lines of their work.

I must digress a little here to speak of a friend who once undertook lines of work that he found would not keep company. He was running a cotton-mill successfully, and having power to spare concluded to manufacture printers' ink in an adjoining building. I need not tell your printers that the cotton lint that continually floated in the air through those buildings did not enhance the value of the ink when mixed with it, so the ink factory had to go.

There may not be so great an incompatibility between the products of a machine shop, yet there are numerous instances which I have met with, in the experience of manufacturers, where one line of work could only be maintained by drawing on the profits of another. With the co-operative system in use such a condition of things, if existing, would not be likely to continue.

The most objectionable feature, it seems to me, in the co-operative system, may be found in the method of arriving at the price of any particular machine, and thus publishing to the world, as it were, its exact cost. This, from a business standpoint, is unwarranted in all commercial transactions, and is nowhere more objectionable than where the inquisitive American character prevails.

When, however, a line of work has become established and shop prices for same fixed, it obviates the necessity of estimating costs, as when new and original machines are contemplated, so that the contract system in this case becomes practically another form of profit-sharing, and only differs from an annual or semi-annual distribution of profits in that the interests of the workmen in the first instance are enlisted in the cost of each machine, or lot of machines, while in the latter case they only care for general results—incentives equally strong to inspire diligent service.

Many industrial enterprises of all kinds are now successfully employing a profit-sharing plan, and such is the general interest taken in it that only recently, I believe, a company of representative men have been formed to promote the introduction of this system.

One of the largest of Western shops has employed for several years a system differing from either of those named, and in some respects superior. Here machines are not estimated on as a whole, but contracts are entered into with certain workmen for certain parts of the work. For instance, one or more molders agree to make and deliver in the machine shop, perfect castings at a fixed price per pound. All foundry facilities and material being furnished by the company. These contractors, and the men they employ, are paid ordinary wages statedly, and these amounts stand charged against credits accruing from the delivery of castings.

In like manner certain workmen engage to erect a number of machines at a fixed price, and they employ enough help to accomplish the task in the stated time. When completed they receive whatever difference may exist between the amount paid themselves and men as wages, and the contract price.

Such contracts will necessarily have a great range, and, indeed, extend down to individual operations, or piecework. In this way the concern may contain a number of *working foremen* which assist greatly in conducting shop affairs.

In these methods it will be seen that all workmen do not share in whatever bonus may be earned by the contracting parties, but while it is not obligatory upon the "gang boss," as he is called, to share his excess of earnings, yet such liberality is often found in them, and it is noticeable that such acts always draw around such persons the best and most willing help.

The system enables accurate costs of complete machines to be kept at the office, so that all matters of this kind remain with the management, where they properly belong.

"QUIRK."

Cam Roll for Compressing Shoe Heels.

Editor American Machinist:

Referring to a recently published question and answer in regard to cam rolls for compressing shoe heels, I would say make your shaft and roll of Lowmoor iron. Have it case-hardened (by the same process as smaller articles are done in bulk) by continuous heat, encased in animal charcoal or bone dust.

You will find you have a roll of the hardness of tool steel to any depth you choose to make it according to the length of time it is kept under heat, and for wearing qualities far superior, still retaining its form, size and strength in the fibrous structure of the interior. I can refer you to parties who are using it for cams and cam rolls and ratchets, etc., where very severe work is required of them, and they will outwear tool steel several times over by actual test. My own experience in several articles made of it is the same—it would be cheaper and easier made. Irregular shaped pieces made of it retain their shape in the hardening process. The same you cannot say of tool steel.

Newtonville, Mass. J. H. WALKER.

Babbitting Solid Boxes.

Editor American Machinist:

As a suggestion to Mr. Haines for babbitting solid boxes, I have several times made use of asphaltum varnish applied to the journal and allowed to dry. This will not consume much time, as it dries rapidly. It may be laid on to almost any desired thickness, according to size of journal or required looseness of fit. Care should be taken that it is evenly applied; then after pouring box, pour on turpentine or gasolene to cut the varnish, and the shaft may be readily removed.

I have also in cases where the shaft might be readily driven, used very thin tissue paper, such as may be found at any grocery or tobacco store, well oiled to make it adhesive, wrapped on to shaft to required thickness, and usually find no trouble in removing shaft.

The varnish will usually be found most convenient, as it is not necessary to even remove the shaft after filling if the job is well done, and I have in extreme cases filled boxes on small places in shafts where it would be impossible to remove the box without melting the babbitt out, yet had no trouble in securing a good running fit. I find most trouble with solid boxes, not in filling the box, but in keeping the babbitt tight in box after it is filled. I know of no other way than drifting, but that is not practical in a jobbing shop where every box is a different size. Perhaps some of your readers might give us their experience in that line, as I have no doubt someone has found a way to overcome the difficulty.

Coldwater, Mich. BABBITT.

A Peculiar Chip.

Editor American Machinist:

I mail you to-day a short piece of "chip" made whilst turning a piece of 1⅝-inch machinery steel. I thought perhaps you might like to illustrate it, as I think its peculiar appearance might interest some of your readers, and at the same time I should like to know if any of them have come across anything similar.

A CHIP.

The cut was made by a "racker" tool with a feed of about 20 to the inch, and, as you will see, the chip resembles a roughly cut screw 1⅛ inches diameter, 12-pitch, the angle of thread being nearly correct; the chip was made on a 20-inch Flather lathe, by Joe Fraser, one of the hands in my department; he afterwards tried repeatedly to reproduce it, but failed in every instance, and I am inclined to think that it will prove a hard task to make one like it under similar conditions.

RICHARD THIRSK, M. M.
Columbia Mills Co.

Columbia, S. C.

[We present an engraving of the chip, life size, and consider it a curious example. —ED.]

Train Resistance.

Editor American Machinist:

In the AMERICAN MACHINIST for February 14th, Mr. R. E. Horton again defends himself from my criticism of his original article on "Train Motion and Resistance." In this last communication he says that the error of 21 per cent. which I found in his formula, by applying it to the Empire State Express is due either to a "misconception of the principles . . . or to the use of experimentally determined constants which do not apply to the somewhat extreme case. . . ." As to that, his formula is certainly clear enough to substitute in, and the values that I did substitute in it I obtained from the table he gave, and if he considers that 90 miles an hour is an extreme case to which his formulæ do not apply, I fail to see why he tabulates values calculated by his formula for velocities up to 150 miles per hour.

But, again, Mr. Horton's "error" may refer to my assumption of 26.6 as the per cent. of boiler pressure realized as mean effective pressure at a piston speed of 1,440 feet per minute. I have in my possession a table giving the results of experiments up to 1,400 feet, so that the case under consideration can hardly be called an extreme one. If the figure is in error, it is in excess of the correct per cent.

If Mr. Horton did not mean his figures and tables to be taken seriously, he should have said so. He gave values for high speeds, and I used them. Perhaps that is where my mistake lies. He says that "not more than 85 to 90 per cent. of this (maximum) velocity could be depended on for a continuous run." I was not aware that he employed a factor of safety, but knowing it now, I shall not attempt any more calculations by his formulæ.

Once more, let me reiterate my claim in a condensed form: "*There is no formula extant for train resistance which gives reliable results when the speed of the train is over 50 miles per hour.*"

C. W. MACCORD, JR., M. E.

The New Screw Thread.

Editor American Machinist:

I have noticed the discussion of the new 29-degree screw thread with some interest.

So far your correspondents give their experience with large screws cut with a tool.

Five or six years ago I needed a small screw that would meet the following requirements—a screw that would work under considerable end pressure with little friction and no side shake.

Size of the screw is about ¼ inch diameter by 40 threads per inch; lengths of the nuts in which the screws work are $\frac{5}{16}$ inch to ½ inch.

The V-thread was abandoned at the beginning, as it would meet neither of the above requirements.

Then I tried a thread with about 15 degrees angle of side from perpendicular, which was a success.

The above taps and dies cut freely and smoothly; are quite durable, except that a tooth now and then will break if the tap is a little too hard.

Have made several thousand of the screws in the past five years.

I would have used a genuine square thread if there appeared to be any chance of its filling the bill.

I wish to say a few words in regard to calipers. Whatever advantages the spring calipers may have in small work, it cannot be gainsaid that riveted calipers, when well proportioned and made, are very reliable calipers for small as well as large work.

When I started to learn the trade I bought several different styles of spring calipers, but later on, after becoming accustomed to riveted calipers, I always preferred the latter for close calipering and jobs that were a considerable distance from the lathe. It took a little longer to set these calipers than the springs, but when once set I could always depend on them.

Milwaukee, Wis. FRED. A. WELLES.

A Cheap Planimeter.

Editor American Machinist:

M. E.'s reply to my article, "A Cheap Planimeter," issue January 10th, is good and to the point, as I find an error in working out the indicator diagrams too large to lose sight of or disregard, but to find the areas of cross-sections in machine design it is better than guessing, or the usual way of measuring. F. B. HOWELL.

In our issue of February 21st we reprinted from the Boston *Herald* an item referring to an alleged difficulty that had arisen between a Maine tool builder and a New England machinery dealer, and the unique method adopted by the latter to get revenge. We did not then, and do not now know the identity of either of the parties, but we are informed that a great many who noticed the item, have taken it for granted that Messrs. Hill, Clarke & Co., of Boston, are the dealers referred to. This is not correct, and we are assured that not only has no such incident occurred in their business, but that their relations with the only builder of lathes they know of in Maine, Messrs. Fay & Scott, of Dexter, are entirely cordial and satisfactory.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

Horace B. Miller, Pres't and Bus. Manager.
Charles W. Biglow, Treas. and Sec'y.

Fred J. Miller, Editor and Mechanical Engineer.
J. G. A. Meyer, } Associate Editors
Chas. M. Jones, } and Mechanical Engineers.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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$4.00 a year to Other Countries, postage prepaid.

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Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.
No Commission allowed to Advertising Agents.

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Publishers' Agents, New York.
DEALERS SUPPLIED BY
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The Baltimore News Company, Baltimore, Md.
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Subscriptions received in Paris, France, by E. Terquem, 31 Boulevard Hausmann, at 21 francs per annum, postpaid.

ubscriptions received in Australia by W. Williams, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, MARCH 7, 1895.

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Machine Shop Milling.

We publish in this issue the last of a series of articles on "Machine Shop Milling," which articles we think have done very much for the enlightenment of mechanics who have devoted comparatively little attention to milling, and we know that they have been followed closely and with much interest by those, as well, who know most of the subject.

Though milling machines have been used for a long time, it seems probable that those who are most interested in them are only just coming to an adequate conception of the possibilities of milling operations.

The first conception of milling was, we believe, as a substitute for filing, and naturally this gave the idea of small, fine teeth, each cutting a chip of almost infinitesimal thickness. In our issue of January 17th we published an engraving of a milling cutter made and used by the celebrated French mechanic, Vaucanson, probably something more than a hundred years ago. The teeth in this cutter were evidently cut by hand, and in their arrangement and spacing it is apparent that the filing operation was in mind as an analogous process, it being a fair inference that the teeth would have been formed by the regular file cutters' methods, had it not been for the difficulty of preserving by that method the exact form desired. A cutter made in this way cannot be crowded much under any circumstances, and with absolutely no facilities for sharpening it, except by annealing and filing, crowding and consequent relatively rapid dulling was to be avoided.

There are yet many milling operations which, from the nature of them, can be most economically done by light feeding, in fact, many in which no other kind of feeding can be done at all. But in many other operations there is practically no limit to the feed that can be employed, except that imposed by the limit of the strength of the machine, or its driving power. If a surfacing cut is to be taken from a heavy casting, for instance, there can be no doubt but that cutters can be made and inserted in a head to make an end mill, each of which cutters will be capable of taking a chip as heavy as could be taken by a planer tool operating upon the same piece. It is simply a problem of properly shaping the cutters, and then driving them in a machine capable of backing up the work in respect of stiffness and driving power.

If this idea is ever fully carried out, and roughing and finishing cutters are used in a machine designed more or less closely upon the lines of Professor Sweet's "Traversing" machine, illustrated and described in our issue of May 26, 1888, or the more recently shown "Ingersoll" machine, but with far greater driving power, and far greater lateral rigidity of uprights, feats may be performed in finishing cast-iron surfaces that are at present scarcely conceivable.

For such a machine a radical departure would have to be made in the form of upright, because unlike the planer the principal stress would be lateral instead of in line with the movement of the bed, and it would probably be found also that radial surfaces on the cutters would have to be abandoned, and "rake" given the tools so that they would *cut* rather than crush the chip off. Scrapers that take the lightest chip known in machine shop practice have no rake, or, rather, they have negative rake, but tools that must take a heavy chip must have rake to work well.

Feeds have been mentioned in the series of articles just closing that, no doubt, have come as a revelation to many, but it is morally certain that much heavier ones will yet be employed.

We cannot, of course, pretend that these articles have covered the whole field of milling. They were intended originally to cover only one department of it, and it was soon found that it would be impossible to cover even that thoroughly without extending the series to greater length than seemed advisable. We have by no means abandoned the subject, however, but shall bring out other matters pertaining to it, as from time to time it seems advisable or necessary to do so.

Thin Versus Thick Fires.

A statement is making the rounds of the technical press to the effect that there is considerable economic gain in carrying thin fires in steam generators—tabular data of experiments made showing marked decrease of fuel burned for the lighter beds of coal.

As a matter of fact, economy in steam raising is more a question of "general average" than of mere depth of fire, or any other single factor, and the weight of coal per unit area of grate that gives excellent results with a certain draught pressure, firing interval, etc., is entirely inadmissible under different conditions.

A thin fire requires, and during an experiment would receive, greater care in maintaining even distribution of the fuel, and with a draught just suited to the rate of combustion, the total fuel consumption being also properly related to the special radiation losses and heating surfaces, the efficiency of the boiler would be a maximum as regards water evaporated per pound of coal.

But let the same boiler require forcing, for increased demands on the power, more coal must be used per hour, and the draught therefore increased.

If the same thickness of bed be maintained, the furnace door must be opened oftener, in direct ratio of the fuel burned, and the amount of air passing through uselessly, will be approximately as the *square* of the coal consumption.

If the air used was correct for the first rate of steaming, it will be in excess for the second case, and the furnace temperature will fall, resulting in loss of efficiency, and this can only be remedied, in regular practice, by carrying a heavier bed of coal, and keeping to the original firing interval.

Where forcing is necessary, the heavier bed allows of "side firing"—coaling alternately at sides of furnace—and this maintains more even heating effects than where the raw fuel is thrown over the whole grate at once.

The grade of fuel also calls for consideration, different brands of coal requiring each its particular layer depth for the most thorough combustion, and the manner of inducing the draught, whether by a chimney (or its equivalent), or by increasing the ash pit pressure, very greatly affects the performance.

Laboratory engineering is a pleasant, and at times a profitable employment, but those who indulge the spirit of exact research should carefully guard against the drawing of general conclusions from isolated instances.

Proper encouragement to a genuine fireman will be found of far more benefit in reducing the costs of steam generation than all the hard-and-fast regulations as to depth of fuel, etc., etc., that can be devised and kept in force for regular every-day running.

The End of Congress.

By the time this issue of the American Machinist reaches our readers, Congress will have adjourned and its members will have gone home. This we regard as an unmixed blessing, and it is to be sincerely hoped that it will be a long time before another such Congress—a Congress capable of doing so much to unsettle business, and at the same time so little in the way of positive legislation in the line of the professed principles of its majority, or of any other principles—will be again assembled.

The people of this country respect men who are sincerely and consistently devoted to principles. They also respect legislators who consistently stand up for their professed principles. When such legislators make mistakes, they are honest mistakes, such as erring humanity is ever subject to, and these mistakes can be remedied by subsequent legislation enacted in the light of experience. But in this Congress, we are sorry to say, very little of sincerity has been manifested. There has been little apparent inclination to consider the welfare of the people of the country, but instead a consuming desire to put somebody "in a hole" or to advance the interests of certain seekers for the presidential nomination, to say nothing of the flagrant corruption which has impudently flaunted itself upon the floors of Congress. In these practices men of both parties have been engaged, and the interests of the people who sent them there have been practically ignored.

There has never been a time during the existence of the Congress when it would not have been possible to have enacted wise and beneficial legislation if only partisan or personal interests could have been subordinated to the people's interests.

With the adjournment of Congress one more obstacle to the return of prosperity will be removed, and it is expected by most of those best qualified to judge that by next fall at the latest, if not sooner, business will again be in good condition.

A Compound Locomotive Performance.

They tell of a locomotive engineer running one of the modern compound locomotives, who, "suspicioned she wasn't just all right, but she worked better and pulled more cars, and so he said nothing and sawed wood." But when she went into the shop it was discovered that the piston in one of the low-pressure cylinders had come off the rod and was stuck in one end of the cylinder, the rings having expanded in the counterbore so as to hold it, and the rod had been simply pumping in and out without doing any work.

Whether this is a joke on the engineer or on somebody else depends upon how you look at it; but it is "an ower true story."

Literary Notes.

We have received a copy of the second edition of Mr. Addison C. Rand's book, entitled "The Uses of Compressed Air," with illustrations. The fact that this book has so soon reached its second edition indicates that it has met with a favorable reception from those who are interested in the compression and uses of compressed air. It is published by the Republic Press, New York.

THE INDICATOR, AND ITS PRACTICAL WORKING.

This work, which is published over the signature of A. G. Brown, by the Globe Engineering Co. (Limited), of Manchester, England, in illustration of the Tabor indicator, manufactured by the company, describes the instrument and gives instructions for its proper handling.

Cards taken from steam, air, and gas engines, and tables of the properties of steam, etc., are included in the work, making it a very handy reference volume. We notice that the latent heat of fusion of cast-iron is given (Table No. 48) as 2.33, and as there has been no authoritative determination of the true value, it would seem the proper course to mark such quantity as doubtful.

The table of relative proportions for multi-cylinder engines might have been suppressed, without detracting from the value of the work, because these proportions are not fixed, but must be made to suit conditions.

The book is of convenient size, the type is clear, and the cuts excellent, and those who are interested in steam will find much in the volume that is of value.

We have received from the Railway Equipment and Publication Co., 326 Pearl street, New York, a copy of a book called "The Pocket List of Railroad Officials." This book gives a table showing number of miles operated, gauge, rolling stock equipment, etc., of all the railroads on the North American Continent, alphabetical list of officials, giving their names and titles, and the number of railroads with which each official is connected; headquarters of the companies arranged by cities, showing the

towns where officials have headquarters, with the roads to which they are attached, and general information regarding the town. The book contains very much information of value to those who have business with railroads. We are not informed as to its price.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(86) T. S., Sharpsburgh, Pa., writes: Please inform me what acetylene is, and what it is made of. *A.*—Acetylene is a colorless inflammable gas with a disagreeable odor, found in coal gas, also produced in cases of incomplete combustion of hydrocarbons.

(87) G. W. W., Steelton, Pa., writes: Please give title of a good book, and where it can be obtained, treating on bridge and construction work. I want one that is thorough and practical. *A.*—"The Design of Structures," a practical treatise on the building of bridges, roofs, etc., by S. Anglin, published by J. B. Lippincott Company, Philadelphia, Pa., may suit you.

(88) C. & H., Champaign, Ill., write: Will you please inform us how to polish celluloid, or would it be transparent if it was cut with a milling machine? *A.*—This query was referred to the Celluloid Co., New York, which controls the manufacture of that material. They reply that "celluloid can be polished by the same methods that are used for hard rubber—a cloth buff wheel with fine emery powder, and then finished with rotten stone, is what we use." It is not likely that it would be very transparent after milling unless polished, though a simple test would quickly decide this.

(89) E. B. F., Chicago, Ill., asks: Can you inform me where I can find, or can you give me a formula for computing the length and diameter of wire for a given note; this wire is to be used for spiral steel wire bells in clocks; also give diameter of spiral and number of turns. *A.*—This kind of work is somewhat out of our line; we have, however, endeavored to find the required formulæ, but failed to do so. We are inclined to believe that you will have to determine the size of wire, etc., by experiments. 2. Must the steel for these spirals be tempered? *A.*—For the higher grades of clocks, we believe they are tempered, otherwise the wire will not retain the note very long.

(90) G. W. S., Centerville, Iowa, writes: Please state the basis of measuring the capacity of black lead crucibles. We see in catalogs that water is what they base them on. Is this generally used? *A.*—This question was referred to the Jos. Dixon Crucible Co., Jersey City, N. J., and they answer as follows: There is no recognized certain measuring capacity for black lead crucibles. When we wish to measure a crucible exact in our shop and get the cubic contents to a hair, we use water. Quite often foundrymen who have disputed the size of their crucibles saying another man makes them a little larger, measure them with sand. Our men are instructed to measure them with water, as the sand can be shaken down to make the crucible hold more than if unshaken. We sell our crucibles on the capacity of so many pounds of melted metal to the number. Take, for instance, a black lead crucible No. 50. We sell it on the strength of its holding 3 pounds of melted metal to the number.

(91) E. E. E., Portsmouth, Va., asks: Why does a big gate on aluminum castings make a hollow or draw greater than a small gate? The difference is so great the molders are at a loss what to do in gating aluminum castings. Castings and gates drawing with big gates cut on them is contrary to the laws of molding and the nature of the metal. If you have any information about the nature of the aluminum, proper temperature to pour, etc., it will be appreciated. *A.*—These inquiries were referred to Mr. James C. McGuire, New York, representative of the Pittsburgh Reduction Co., who replies as follows: In regard to a large gate on aluminum castings making a greater hollow or draw than a small gate: in the case of the large gate the shrinkage is mostly in the gate. In the use of the small gate the shrinkage is distributed more throughout the casting, the total amount of shrinkage in the case of the small gate being not as perceptible as when using a large gate; in the former case it is not in any one place, but more distributed. Aluminum castings should be made with as large and as high a gate as possible, in order that the shrinkage may be all in the gate. In using a large and high gate you have a greater head to your metal when in the liquid state, thereby forcing it to distant parts of the mold, and getting a more perfect casting than you otherwise would. Aluminum melts at about 1,160° Fahr. It should be poured as near this temperature as is practicable. After taking the metal off the fire it should be cooled down with some ingot aluminum in order to reduce the temperature as near to 1,160 degrees before pouring as possible. It is particularly desirable that in melting aluminum, and especially alloys of aluminum, the temperature should not be raised any more above the melting point than is absolutely necessary; the plumbago crucible being the best form of crucible to use in melting aluminum, and sand molds the best molds for casting.

(92) F. P., Houston, Texas, writes: I have a water main with 45 pounds pressure per square inch; I wish to attach a hose 100 feet long and 2½ inches in diameter with ¾-inch nozzle. 1. What will be the velocity of water through the nozzle? *A.*—The head due to a pressure of 45 pounds per square inch is $2.304 \times 45 = 103.68$ feet. In order to find the velocity at end of the nozzle we must first find the velocity in the hose, which we shall assume to be of rubber. This velocity is found by the following formula:

$$v = \sqrt{\frac{2\,g\,h}{m + f\,\frac{l}{D} + (1 + m_1)\,\frac{D^4}{d^4}}}, \qquad (1)$$

in which v = velocity in feet per second in the hose, f = a friction factor, which for rubber hose we may take at .03, l = length of hose in feet, D = diameter of hose in feet = .208, d = diameter of small end of nozzle in feet = .072, m = loss due to entrance at hose, for which we may take a value of .5, m_1 = loss due to entrance in nozzle, for which we may take a value of .041, g = 32.2, and h = head in feet = 103.68 feet. Substituting these values for the letters in formula (1), we have $v =$

$$\sqrt{\frac{2 \times 32.2 \times 103.68}{0.5 + .03 \times \frac{100}{.208} + (1 + .041) \times \frac{.208^4}{.072^4}}}$$

$$= \sqrt{\frac{6,676.992}{0.5 + 14.42 + 1.041 \times 70}}$$

$$= \sqrt{\frac{6,676.992}{87.79}} = 8.7 \text{ feet per second.}$$

The velocity through the opening of the nozzle is now found by the following formula:

$$V = v\,\frac{D^2}{d^2},$$

in which V = velocity in feet per second, and the other letters denote the same quantities as before. Hence we have

$$V = 8.7 \times \frac{.208^2}{.072^2} = 70.9 \text{ feet}$$

per second. 2. How many gallons will be discharged per second? *A.*—Multiply the cross-sectional area of the hose in square feet by the velocity of water in the hose in feet per second, the result will be the number of cubic feet discharged per second, multiply this product by 7.481 (which is the number of gallons in one cubic foot) the result will be the number of gallons discharged per second. The area of a section 2½ inches diameter is .034 of a square foot, hence we have

$$.034 \times 8.7 \times 7.481 = 2.21 \text{ gallons}$$

per second. 3. How do you find the pressure lost by friction in the hose? *A.*—First find the head lost by friction by the following formula:

$$h = f\,\frac{l}{D}\,\frac{v^2}{2\,g} \qquad (3)$$

in which h = loss of head in friction, the other letters denote the same quantities as before. From this formula we get

$$h = .03 \times \frac{100}{.208} \times \frac{8.7^2}{2 \times 32.2} 16.87 \text{ feet,}$$

and the pressure in pounds per square inch due to this head is

$$16.87 \times .434 = 7.32.$$

4. How much does the nozzle increase the pressure in the hose? *A.*—None. 5. To what hight can the water be thrown with this nozzle? *A.*—With a smooth nozzle, under favorable conditions the water can be thrown to a hight of about 50 feet.

(93) E. W., New York, writes: The ratio of gearing in a broaching machine is 15 to 1; the fly wheel makes 134 revolutions per minute, the weight of the fly wheel is 477 pounds, the mean diameter of the rim is 31½ inches, outside diameter 36 inches, over which the driving belt, 4 inches wide, runs, the work to be broached is $\frac{9}{16}$ inch, the stroke of the broach is 6 inches. What will be the pressure during broaching? *A.*—In order to compute the pressure exerted during broaching we should know the velocity of the fly wheel at the beginning of broaching, and also at the ending, in other words we should know the loss of velocity of the fly wheel while the broach passes through the work. We shall assume that the velocity of the fly at the beginning of broaching is 136 revolutions per minute, and at the ending 132 revolutions, giving a mean velocity of 134 revolutions per minute. The linear velocity per second of the mean circumference of the rim (31½ inches diameter) at the rate of 136 revolutions per minute is 18.69 feet. The stored-up energy in the wheel at this speed is found by the following formula:

$$\frac{W}{2\,g} \times v^2 = E \qquad (1)$$

in which W = weight of fly wheel in pounds, g = acceleration per second due to gravity = 32.2 feet, v = linear velocity per second, and E = stored-up energy in foot-pounds. Substituting for the letters their values, we have

$$\frac{477}{2 \times 32.2} \times 18.69^2 = 2,584.93 \text{ foot-pounds.}$$

At the rate of 132 revolutions per minute, the linear velocity per second of the fly wheel rim will be 18.14 feet; and the stored-up energy at this speed will be according to formula (1)

$$\frac{477}{2 \times 32.2} \times 18.14^2 = 2,435.04 \text{ foot-pounds.}$$

Subtracting this stored-up energy from that of the higher speed we have 2,584.93 — 2,435.04 = 149.89 foot-pounds of energy expended in doing work. At the mean velocity of 134 revolutions per minute the broach will make 0.15 of a stroke per second, and if the broach does work during the whole stroke of 6 inches, then work is performed through a distance of $.15 \times 6 = .9$ inch = .075 foot; and since 149.89 foot-pounds of energy have been expended during this time the average pressure on the broach will be $\frac{149.89}{.075} = 1,998$ pounds. To this we must add the pressure due to the belt. If the belt exerts a driving force of 65 pounds per inch of width then the total driving force at the circumference of the fly wheel is $65 \times 4 = 260$ pounds. The radius of the fly wheel is 18 inches, and the length of crank at the broach is 3 inches, this gives us a ratio of 6 to 1; and the ratio of the gearing being 15 to 1, the pressure of the crank pin must be $6 \times 15 = 90$ times greater than the driving force of the belt, hence, when the crank stands at right angles to the direction of motion of the broach, the pressure on the crank pin will be $260 \times 90 = 23,400$ pounds; adding to this the pressure due to the stored-up energy given out by the fly wheel, we have a total pressure of 23,400 + 1,999 = 25,399 pounds, or 12.7 tons. In these computations we have made no allowance for friction, if 50 per cent. is allowed then we have 6.35 tons actual pressure on the crank pin, or an average pressure of $6.35 \times \frac{\pi}{2} = 6.35 \times 1.5708 = 9.97$ tons on the broach. 2. The gearing of this broaching machine was changed to a ratio of 45 to 1, and speed of the fly wheel increased to 310 revolutions per minute, what increase of pressure will these changes give? *A.*—Before the change and with a speed of fly wheel of 134 revolutions per minute, or a linear velocity of 18.41 feet per second, the stored-up energy in the fly wheel will be according to formula (1)

$$\frac{477}{2 \times 32.2} \times 18.41^2 = 2,508 \text{ foot-pounds.}$$

At 310 revolutions per minute the linear velocity of the rim of the fly wheel will be 42.6 feet per second, and the stored-up energy will be

$$\frac{477}{2 \times 32.2} \times 42.6^2 = 134,292 \text{ foot-pounds,}$$

or, $\frac{13,429}{2,508} = 5.2$ times greater than when running at the slower speed. At the slow speed the broach makes 9 strokes per minute, and at the increased speed and increased ratio of gearing the broach makes 7 strokes per minute, very nearly, hence, in bringing the fly wheel to rest under both conditions in the same time, the pressure due to the stored-up energy will be

$$\frac{9}{7} \times 5.2 = 6.7 \text{ times greater}$$

at the increased speed than at the lower speed. We have seen that at the slow speed the pressure on the crank pin due to the pull of the belt is 23,400 pounds. At the increased speed the pressure will be $260 \times 6 \times 45 = 70,200$ pounds, consequently the pressure due to the belt at the increased speed will be $\frac{70,200}{23,400} = 3$ times as great than at the slow speed. Hence in making the change the pressure at the beginning of broaching will be increased 6.7 + 3 = 9.7 times.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue

Gear Wheels, Gear Cutting. Grant; see page 192.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Cam-Milling. Machine Tool Works, Newark, N.J.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engine Castings, 1 to 6 Horse-power Vertical. The Humphrey Foundry, Bellefontaine, Ohio.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

American packing rings are in touch with the cylinder. New circular about rings and pistons. J. H. Dunbar, Youngstown, O.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Radial Drills for every possible duty from the Smallest to the largest, built by C. H. Baush & Sons, Holyoke, Mass.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Gumming the Patternmakers' Saw.

BY JOHN M. RICHARDSON.

The following is intended for patternmakers, or, in fact, any woodworkers who may wish to true the teeth of a circular rip saw, and are not so situated that they can conveniently have it gummed on an emery wheel:

After a few months filing almost any saw will show its teeth much reduced in size, even if the shape has been fairly well preserved, and it becomes needful to have the throat or gullet of each tooth enlarged to a uniform size. This is commonly called gumming.

Large mill saws are gummed by clamping a certain device to the disk which stands directly over the teeth, and contains a cutter similar to one used on a milling machine. By turning a crank the cutter is made to revolve, and the feed is regulated by a hand wheel attached to a screw. This needs frequent turning, as is the case with certain ratchet drills.

Sometimes, however, the gummer is provided with an automatic feed, and in either kind a stop is provided, so that the cutter cannot go beyond a certain depth.

Shop saws are commonly gummed by holding them in a horizontal position over a rest against an emery wheel of a proper shape to form the required throat. This is an expeditious method, as, of course, an emery wheel will cut faster than a file, but my purpose now is to describe how the gumming can be done another way.

Before removing the saw from the arbor joint it perfectly true by holding a piece of fine emery brick, or old piece of oil stone, squarely against the teeth until the effect can be discerned on the point of every tooth.

In order to have the jointing process of any value the saw must always hang in the same position on the arbor, and if the mandrel hole is a little large then this becomes all the more imperative.

The saw arbor being perfectly round it makes no difference at what point it comes to rest, whether the hole in the saw be a close fit, or much too large; but if a saw with a hole having a loose fit be clamped to the arbor haphazard, and then jointed, it will be all right so far; but if it be placed on the arbor haphazard the *second* time, and started to revolve, it will have an eccentric rather than a circular motion.

Every circular saw has the maker's name on the disk, and if one would always remember to place it on the arbor with the name upwards before tightening the collar against it, then the saw would always hang in the same relative position upon the mandrel, and would show no wobble when started up.

One way is to scratch a place on the edge of the collar, and to match it upon the saw just opposite, but this is no better, and is not as quick, for it necessitates turning the arbor until the scratch comes in sight before the saw can be tightened against it.

The amount of "set" in a saw plays a very prominent part in the quality of work done, and no matter how well the teeth may be shaped, or how sharp they may be filed, the stock will have a ragged appearance after it has been cut if there is the slightest irregularity in the setting. The less set the better, provided the saw will pass freely through the work without binding, as the narrower the kerf the less resistance there is in feeding in the material.

The great thing to be avoided in setting a saw is bending one or more of the teeth somewhat more than the others, thus giving those most bent an extra duty to perform; this duty being most detrimental to good work, as it is simply tearing the fibers of the wood in a plane entirely outside that which the other teeth are traveling in. I will not attempt to give any particular method of setting as the very best; for one man will, perhaps, use a block of cast-iron having a planed surface and a stud driven in vertically at one end on which to place the saw, the stud being just the diameter of the hole, and at a distance from the center of this, equal to the radius of saw, there will be a little place either filed or planed at a slight bevel equal in amount to the required set, and the tooth will be bent by striking the point with a hammer until it lies firmly against the bevel in the block. It is obvious that by this method a tooth cannot be bent beyond a certain amount.

Another man will say that the proper way to do it is to leave the saw on the arbor and use a hand set that pinches the tooth a certain amount similar to the common hand saw sets. When a tooth is bent in this way there must be a slight recoil, and whether this will be absolutely the same for every tooth is a point worth considering.

Another way is the "monkey wrench" plan, which consists of holding a tooth between the jaws of the wrench, using the handle as a lever, and then bending the tooth by guess.

The reader can select either method or invent another, but I advise him to confine his monkey wrench to the legitimate use of turning nuts and bolts.

As soon as the saw is removed from the arbor it should be cleaned with a rag or piece of waste wet in turpentine if the teeth are gummed up to any extent with pitch, as it is much better to lay out teeth on a clean surface.

In a circular rip saw the front edge of the tooth produced should be tangent to a circle from $\frac{1}{2}$ to $\frac{5}{8}$ the diameter of the saw itself. I consider $\frac{1}{2}$ the diameter easier to remember, and at the same time it makes the tooth very slightly stronger, and as for the difference between the two in cutting (for small saws, at least) it is not worth mentioning.

Fig. 1 shows a template to use while laying out teeth, which is extremely simple, and will take but a comparatively short time to make. It consists of a thin piece of wood about $\frac{3}{16}$ inch thick, with a hole at *A* having a plug permanently fitted, just the diameter of the hole in the saw, and projecting through both sides a distance about equal to the thickness of the saw plate. The edge *b c* is tangent to half the diameter of saw, and *H* is a small hole in which to insert the point of a hard lead pencil to be used as a tram in describing a circle to be used as a guide for the gullets of the teeth.

To use this device, place it over the saw, having both in a horizontal position, and after the circle just spoken of has been made, bring the edge *b c* against the point of a tooth, and lightly trace a line between the circle and the point, with a sharp scratch awl. Do this to every other tooth, then turn the saw around and place the template over it once more, in the reversed position, and describe the circle with a lead pencil, as before, also the lines on the remaining half of the teeth. The saw is now ready to be held in a clamp and filed.

The clamp shown in Fig. 3 is as good as any, and very simple, being two boards

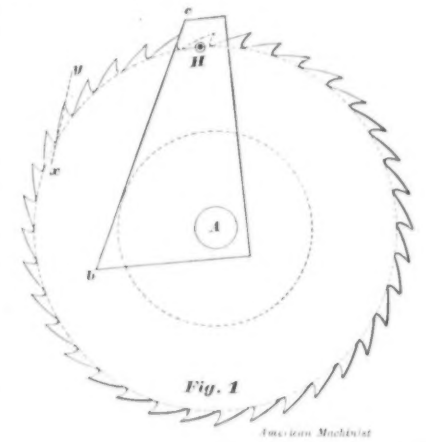

Fig. 1

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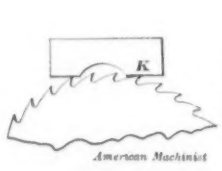

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Fig. 2

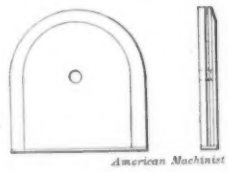

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Fig. 3

Gumming Saws.

sawn to the outline shown; the radius of curve being a little less than the roots of teeth when saw is in place. A piece of leather is nailed across the bottom of each for a hinge, and the two boards should be separated at the bottom slightly more than the thickness of the saw, so they can act as a clamp to pinch the saw tightly when placed in a vise. A hole is bored through both pieces, and a pin glued in the back one, projecting very slightly into the hole in front. The saw should turn easily on this.

As soon as the saw is clamped in position, it is ready to have the teeth chambered, which is done with a round file, known in some localities as a "rat tail file," making a curve tangent to the circle drawn with template, and also the line to the tooth point, but if it falls a trifle behind this line it will do no harm, and some might consider it an advantage; but it must not go inside the line of the circle.

The distance from this circle to the outer circumference of teeth should be somewhat less than half the distance from the point of one tooth to the point of the next.

After every other tooth has been treated in the manner described, with the round file, reverse the saw, and do the same to the rest. I now come to a very delicate point, namely, the shape of the back of tooth and manner of filing; delicate in the sense that about every man has his own idea on that subject, and to express an opinion is "treading on the corns" of somebody. So I will give one of the different methods, and the reader can still continue to file in his own way, as of yore. I would advise filing the back of tooth to a curve similar to that in Fig. 1, as it makes a stronger tooth than one as shown by the dotted line *x y*; but there should be clearance enough, so that if a straight-edge is placed as shown in Fig. 2, bridging over two teeth, it will rest on the point of the first tooth, as shown at *K*, and not at a place some distance behind it.

In regard to the bevel; the back of tooth should be exactly square with the disk of saw, and for the purpose of a rip saw alone, it is as well to have the front edge of the tooth square, also; but as frequently a saw of this kind is used to cut across the grain, especially if the saw frame has but one arbor, it will do no harm to have a slight bevel on the edge.

The action of a rip saw is like a series of chisels, each chopping out a shaving from the stock in rapid succession, and therefore the sawdust from this kind of saw is not "dust," but should be fine, stringy shavings, resembling excelsior. This is more noticeable if the saw only just reaches through the board, for then the cut of each tooth is longer and not so much across the grain as it is when the saw is large and projects much above the stock.

The nearer the circumference of the saw is to the top of the work, the less power it takes to drive it.

Quitting Work Promptly—Large Gas Engines—Electric Transmission—Dangerous Boiler Construction.

By W. H. Booth.

There are two sides to every question.

An item recently went round in some papers that at a certain workshop there was extreme briskness of movement when the bell rang to quit work. It is always this side of the bell question that one reads about. Ask one of the other side—one of the men who hustles to get out—why he thus hustles. It is possible he may reply that the old man is so keen to deduct from his pay when he does not hustle inwards at 7 A. M., on ringing of the bell, that he has got into the way of hustling out as fast as he is compelled to rush in. Why should he be fined when he is on one side of the door, and not paid a bit extra on the other side? Or he may tell you that the bell never rings until fully two minutes past the hour, and it takes him all his time to get home and back again within the hour, and so he is bound to hustle at dinner time, anyhow. Another man will tell you that if he misses the train he can just get by quitting sharp, he has to wait forty minutes for the next one, and it is a slow one, and so he gets home an hour late. Now, if a man works fairly up to the hour for quitting, is there any reason why he should make it a rule to go on working a small period of time beyond his signal to quit? I profess to have some little knowledge of human nature, and I believe that apart from the very numerous cases where there is a very excellent reason for sharp quittance, it is contrary to human nature of the average kind to work after the conviction has arisen that the bell should have rung. It is by no means a question of shirking, but purely a matter of human nature, and I suppose it is also human nature that the employer who pays money should feel himself entitled to growl at the man who sells his labor if the seller does not give overweight. After all, is not a man who starts with the bell entitled to a little consideration? It is not pleasant, perhaps, to any man to feel tied to a minute. It is far preferable not to start to a bell, even though this often carries with it the necessity of not leaving off for hours after others have quit. I would rather work from 7 to 17 hours a day than be tied down hard and fast to 8 or 9, and my sympathies are strongly with men who are thus tied.

If a man has intelligence he is sure to devote it to something outside his business. In the modern system of manufacture, a man who spends nine hours a day faithfully standing at a lathe and reproducing the same detail at so many cents apiece, cannot be said to have much field for exercising his brains. He is given a piece of stock and a machine, with perhaps a turret head and six tools in it. These he receives from the tool room, and if he suggests any improvement it is as likely as not that his suggestion will not be accepted. The method to be followed out has been thought out by someone else, and the machinist is tied down, so far as his work goes, to performing a series of operations, which, after a few days, he can do no better. He spends his days doing this in order that he may live, and follow out something more intelligent in his own time. In this country, the New Local Government Act, which has just come into operation, affords scope for intelligent men to utilize their time, for it compels all business meetings of the Parish and District Councils to be held in the evening, and this will prove the death knell of the system of local government under which London has been swindled by its vestries. As in the days of Dickens, the very name of vestryman is synonymous with rogue. We know they are rogues, even if we cannot bring it home to them. Those of us who are "kickers" are called cranks, but at last we have kicked the system away, and in future public business will be *public*, as it is outside London, where purer methods have long obtained.

If the steam engine is to continue to hold its own for small powers in face of gas engine competition, and electric motors deriving energy from a large and economical engine, it will require to be kept up to the mark, and we may welcome a new make of engine which embodies a means of controlling the low-pressure cylinder equally with the high-pressure. I found some years ago that this was an aid to economy; that it was a mistake to allow the low-pressure cylinder to be supplied with steam in a careless manner, and that what merit there is in expansion it is as important to secure it by attention to low-pressure working as to high-pressure working. There is, however, a proposal here to generate electricity at the coal pits by means of gas producer plants and gas engines, transferring the power electrically to the large centers of population.

The success of the scheme is, of course, based upon the saving in the cost of carriage of fuel, and its greater efficiency when utilized in the gas engine as compared with its use in many steam engines, and the cost of distributing solid fuel. The gas engine is a heat engine working between wide limits of temperature, and though the cooling of the working cylinder is unscientific it is perhaps no worse than the use of a chimney to promote combustion, and the use of no heat higher than that of the initial steam even though the furnace temperature may be five or six times that of the steam. As a whole the gas engine is the more efficient machine, and in certain situations of short working hours it becomes particularly so. There is, of course, nothing impossible in the idea of producing all the energy for power, light and heat at the point of fuel production, nor do these appear good reasons mechanically why large power gas engines should not be perfectly successful. The only difficulty seems to have been in the starting. This I have already shown can be effectually got over by means of small starting engines, themselves small enough to be started by manual power, and there are now frequent illustrations and descriptions in the papers of 300 horse-power gas engines. One such I recently read in a French journal, the engine being worked by cheap gas of the "producer" kind, as we are now learning to call the diluted carbonic oxide, got by blowing air and steam through incandescent coke. Engines so worked are not so powerful as those worked by ordinary illuminating gas which is not supposed to contain any semi or wholly oxidized substance. Hence there is required a larger proportion of producer gas and less air for combustion and dilution, the gas carrying some of its own dilutents.

Respecting the use of electrical motors for shop driving, one of my friends with a works on the Continent informs me that whereas formerly they employed several engines aggregating 300 horse-power, they now have one engine only of 100 horse-power. The reason is obvious. In each department formerly worked by its separate engine this had to be capable of doing a maximum duty of three times the mean duty, the latter being simply the average of a number of machines, some of which were

usually at rest and occasionally all were at work and calling for maximum power. But when the power for the five or six departments was concentrated in one engine, there was saved not merely the engine friction of the several engines, all too big for their normal duty, but there is saved the advantage of one better attended engine, and the variation in load of the several departments, when averaged upon one engine, is found to total up to a very fairly even power, so that on the whole establishment the engine is not called on to vary more than perhaps ten or fifteen per cent. Anyhow, the net result is that the work is now satisfactorily performed for about a third the former fuel expense. Granted that some of the saving is a matter of a better engine, it is equally true that the single engine can be better looked after than the several smaller engines, and it is also probably true that in practice the loss of power in shafts or in steam pipes is far greater than the loss in electrical transmission. It does not, indeed, seem unreasonable to conclude that a few years will show great changes in the production and transfer of power.

I have heard it stated at an engineering meeting that the gas engine could not be used for electric light work because it was not steady enough, and that it could never hope to be steady enough, or words to that effect, because it could only be single-acting. Yet not only is it used for electric lighting with satisfaction, but it also is, and was at the time, double-acting; the idea that a piston rod gland was inadmissible having clearly been a mistaken idea of the kind that prompted the use of toothed wheels in very early locomotives, because smooth wheels were believed, without any experimental evidence, to have no grip of the rails. Speaking of gas and of the underfiring of steam boilers, your leader of December 13th calls attention to the condemnation of English boiler insurance companies of external firing of steam boilers, whereby the shell exposed to tension is also exposed to the fierce heat of the furnace. Especially when the water is bad it is considered dangerous to fire on the outside of a shell boiler. It is probable that this is partly due to the fact that in this country such boilers are very long indeed—simply long cylinders with hemispherical ends, and they are exceedingly liable to "seam rips," a "seam rip" being understood to refer to the tearing of a transverse seam of rivets such as is very apt to take place when cold water is used to wash out a boiler, the upper part of which is heated by the still hot brickwork. Powerful contraction of the shell bottom takes place, and the bottom seams are placed under great stress, the weakest often tearing over an arc of as much as four or even six feet. Longitudinal bolt stays are sometimes put in to hold a boiler together until it blows itself empty, should it be under steam when the rip occurs, as it may do from repeated strainings. The moral is never wash out with cold water, and save the shell as much as possible by not underfiring; but it is probably extreme length that is to blame in many cases. Last week I was through an ironworks. The boilers for working the blowing engines were fired by blast furnace gas, and they were simply egg-ended cylinders 60 feet in length, and exposed to all the stresses incident to settlement of the brick foundations as well as to the above named stresses. The firemen told me they had had several seam rips without any accident. In 60 feet there is a great length for contraction, and the wonder is they have ripped so peaceably. If a boiler must be underfired, it ought to be short like many boilers I have seen in America—not above two diameters long. Seam rips in Lancashire or Cornish boilers are not particularly dangerous, nor need they be in the above type of American boiler, for the furnace and flue tubes hold the ends together until the pressure escapes. I have not in my possession a recent copy of the Rules of the U. S. Supervising Inspectors, but I have a copy some seven or eight years old, and the shell pressures allowed by these rules are enough to frighten any boiler insurance company here. Maybe we are over-cautious, but we have not even yet abolished boiler explosions with all our care—there have been two this week in London, one at least with fatal result—and our rules probably allow only as much pressure on a double-riveted shell as the U. S. Rules allow for the same shell single-riveted, or did allow according to my copy. The placing of many steam boilers in a row is taking a certain risk in the event of one of them exploding. I know of a row of boilers fifty in number, and I see no reason why if one went off all should not go. There have been explosions of three boilers where one only failed first. The separation of the boilers would be extremely inconvenient. Is it not better to prevent explosion? It appears to be safe to say that under the conditions that exist here one of three boilers is not likely to explode, because all such places as have three boilers are under efficient inspection. Where explosions occur there is usually only one boiler, and this is perhaps second-hand, and not even inspected or under skilled attendance. But I have known boilers refused 50 pounds by an insurance company that have been pulled out, sold and reinsured for 60 pounds by the same company. This is no evidence of carelessness. It may be that divested of brickwork in the first case, the 60 pounds would have been allowed right away, and there is, of course, the personal equation of the inspector.

I have just obtained a copy of a set of Graphic Diagrams, published by Griffin & Co., for conversion of measurements from one unit to another. They are simply a series of cross-ruled sheets bound in book form, about 12 inches by 11 inches, with diagonal lines ruled across, and the conversion is done at once by inspection. Tons to kilos, inches to millimeters, pressures in pounds per C M² and pounds per square inch, horse-powers and specific gravity conversions and many others are included. I find them very convenient, and any special diagram not included I can calculate out two extreme values and add the diagram line myself on one of the sheets in, say, red ink. Thus, the allowed pressure in a boiler for different plate thicknesses can be made the subject of one diagram, the datum line being a shell of one foot diameter, and so on, with anything which increases in an arithmetrical ratio, and the "curve" of which is a straight line. The difficulty of efficient inspection is immensely greater in America than it is in England. Even from London, which is not the center of the country, there is hardly a steam boiler more than 12 hours' journey, while nine-tenths of the steam boilers in the country are probably within five hours' journey of the offices of the insurance companies. This fact is hardly sufficiently taken into account when comparing the ratio of English and American boiler explosions, but we may also say that this should be taken into account in fixing steam pressures. In place of a higher pressure, American boilers ought to have a lower pressure allowed, so as to balance to some extent the difficulty of inspection. When a man overpresses his boilers, you may generally find that he is or professes to be a believer in the "something mysterious" that causes an explosion.

There may be an occasional explosion caused by an accumulation of gas in the flues, but practically all explosions arise from the fact that—to quote the words of an old man—"There ain't room enough in the boiler for all the steam that's got into it."

London, Eng.

Jet Propulsion.

By Herman T. C. Kraus.

Some time ago the writer was called upon to roughly determine the efficiency of jet propulsion for small steamers, and for that purpose fitted out a boat with apparatus, and made numerous tests, which are thought to be of sufficient interest to lay before the readers of the American Machinist.

The boat used was 25 feet in length by 5 feet beam, and the immersed midship section was 4 square feet area, and two double-acting ship's pumps, with 6 inches by 5½ inches cylinders, were fastened upon a cast-iron platform resting upon the bottom timbers.

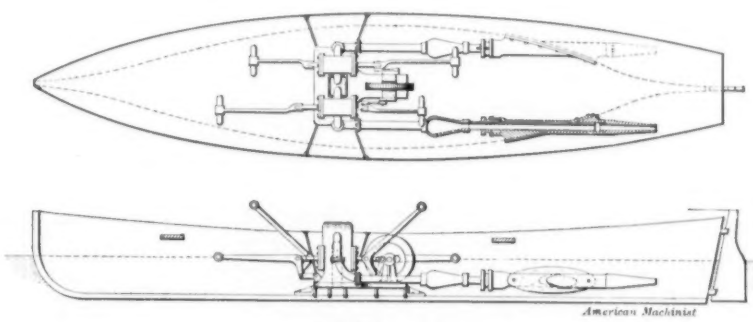
The suction pipes were 3 inches in diameter, and the discharge pipes were 2½ inches diameter, and hand levers of ratio 4 to 1 were fitted for operating the water pistons.

Removable discharge nozzles, 2 inches, 1½ inches, and 1 inch diameter were used in the experiments; the manner of attachment being clearly shown in the accompanying drawings.

The trials were made in New York harbor, a measured distance of 600 feet being set off alongside a pier, and many runs made to get a good average.

Four strong men operated the pump levers, and kept up 50 strokes per minute over the course.

With the 2-inch nozzle the boat made the 600 feet in 8.4 minutes, with the 1½-inch nozzle in 4.16 minutes, and using the 1-inch discharge the speed rose to 600 feet in 2.08 minutes.



Jet Propulsion.

These rates correspond to 0.81, 1.63, and 3.277 statute miles per hour.

The drawing shows horizontal air chambers between the pumps and the discharge nozzles. These chambers were thought to be beneficial by a member of the company, and so were used in the experimental boat. They did not seem to materially interfere with the working of the apparatus.

The trials show the great influence of the discharge velocity upon the efficiency of the system, for the water forced through was practically constant, yet with the small nozzle 1 inch diameter, the speed was four times that due to the 2-inch discharge, or directly as the jet velocity.

Axle Breakage on German Railroads.

The *Practical Engineer* (London) of recent date contains the following on railway axles:

From a report just received it appears that for the year 1893, 85 railroads in the German Railroad Union report axle breakages; having had altogether 1,180,741 axles in use, 78 per cent. of which were steel. On the lines of 32 of these railroads (presumably those with fewest breakages) 151 axles broke. Of these 31 were locomotive axles, and 53 tender axles, so that only 67 were car axles. Of the broken axles 24 were crucible steel, 27 Martin steel, 21 Bessemer steel, and 3 puddled steel. The average life of the broken crucible steel axles had been 18 years, of the Martin steel 6 years, of the Bessemer steel 16 years, of the puddled steel 24 years, and of the iron axles 24 years. The average mileage of the axles previous to the fracture was 254,000 miles for the locomotive axles, 215,000 for the tender axles, and 182,600 miles for the car axles. The average distance run since the last inspection was 19,000 miles for locomotion, 16,000 for tender, and 9,000 for car axles. Fifty-five breakages were discovered while running between stations, 72 while passing stations, 15 during inspections, and 9 after collision or derailments. Fifty were in passenger trains, 4 in mixed trains, 72 in freight, and 2 in work trains. As to the position of the fractures, 68 were in journals, 37 in the wheel seat, 29 close to the wheel seat, 16 in the shaft, and 1 in the crank of a driving axle. Other 21 railroads reporting (presumably those with most breakages) had 94 axles break (and 1,298 the year before). Of these 633 were iron axles, 102 Bessemer steel, 29 crucible steel, 11 Martin steel, and 10 puddled steel. About 1 out of every 700 locomotive axles broke, 1 tender axle out of 862, 1 car axle out of 1,700. In 539 out of 794 cases the fracture was in the journal, and 210 in the wheel seat.

Telephoning to Vessels.

Professor Lucien I. Blake, of the Chair of Physics and Electrical Engineering, at the Kansas State University, at Lawrence, has succeeded at Sandy Hook in establishing electrical communication by wire between the land and a vessel anchored several miles out in the ocean.

The difficulty in accomplishing this has arisen from the constantly changing position of the vessel lying at anchor, and Professor Blake has succeeded by attaching his conductor to the anchor chain (presumably near the bottom) and using that as the conductor to the vessel. The successful experiments were made with the Scotland Lightship.

NEW CATALOGS.

The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, issue a small pamphlet devoted especially to a description of the special points in their new engine lathe.

The Harrison Safety Boiler Works, of Philadelphia, send us a collection of fac-similes of letters recently received from users of their Cochrane separators. These are bound together to form a pamphlet entitled "A Few Opinions Relative to the 'Cochrane Separators,'" and will be sent on application to those interested.

The Swift Lubricator Co., Elmira, N. Y., send us a standard size (6"x9") catalog, illustrating various forms of lubricators made by them. These include sight-feed lubricators for engines, special crank-pin oilers, compression grease cups, etc. The catalog also illustrates steam and vacuum gauges, pop safety valves, injectors, etc.

In our issue of February 14th we noted a new catalog of files issued by the Nicholson File Co., Providence, R. I., and remarked that it was too expensive for unrestricted distribution. We have since received a copy of a reduced form of this catalog, and are authorized to state that the Nicholson File Co. will be pleased to send a copy to any mechanic or file user upon receipt of his address. It is well worth having by anyone interested in files.

MANUFACTURES.

It is reported that an electric railroad is to be built from Tiffin to Fostoria, Ohio.

The Rosena furnace, at New Castle, Pa., will in a few weeks put in a new blowing engine.

The Indiana Stave Company, of Montpelier, Ind., proposes to move its plant to Pine Bluff, Ark.

A number of improvements are to be made on the Youngstown (Ohio) Electric Railway Co.

The Bradstreet Lumber Co. have sold their entire mill plant at South Gardiner (Maine) to Lawrence Bros.

The Plainfield (N. J.) Street Railway Company will extend its lines by the construction of eight miles of trolley road.

G. S. Murchie, of Calais (Maine), proposes to rebuild his grist-mill and elevator as soon as he can make necessary arrangements.

The Chelonsford Iron Co. has just bought the Old Cambridge (Mass.) Rolling-mills, and intend to considerably improve before occupation.

An electric road from Springfield, Mass., to Suffield, Conn., is being talked of. E. K. Bodurtha, of Agawam, Mass., is interested in the matter.

The Norwalk Tramway Company are engaged in erecting a new brick power-house at South Norwalk, Conn.

An addition is to be erected in connection with the plant of the Granite Pressed Brick Company, Woonsocket, R. I.

S. W. Gould and T. H. Anderson, of Skowhegan, contemplate the erection of a large woolen manufactory at East Madison, Me.

J. R. Pearce, of Amory, Miss., is endeavoring to organize a stock company to manufacture an improved engine, and to erect a plant.

The plant of the Union Steel Co., at Alexandria, Ind., is almost completed, and it will give employment to 1,500 hands when it starts.

The Berlin Iron Bridge Co have lately completed an addition to the engine room of the Narragansett Electric Lighting Co., at Providence, R. I.

It seems likely that the Illinois River Bridge Company will receive permission to build a bridge across the Illinois River, near the Hennepin Canal.

It is announced that the Elkhart (Ind.) Street Railway will be completed and placed in operation within twenty days from the time the frost leaves the ground.

The Falls Rivet and Machine Co., of Cuyahoga Falls, Ohio, has secured the business of the Chicago Shafting and Pulley Co., and will enlarge and operate same.

The Baugh steam forge department of the Michigan Peninsular Car Works has started work at its fullest capacity, and has given employment to nearly 500 men.

A brick addition, three stories high and 100x40 feet in dimensions, is to be erected at the Thaver Manufacturing Company's plant on Lagrange street, Worcester, Mass.

The Fitchburg and Leominster Street Railway Company has been granted a franchise to extend its tracks from North Leominster to Whalon, in the town of Lunenburg (Mass.)

The Plume & Atwood Manufacturing Company are to erect a new factory building at Waterbury, Conn. The structure will be of brick, three stories high and 200x42 feet in size.

It is reported that the Reading (Pa.) Iron Co. will erect another new rolling-mill and puddle-mill. The rolling-mill will be 200 by 200 feet in size, and the puddle-mill 100 by 230 feet.

There has been organized in Spartanburg, S. C., the Christopher Double Power Engine Co. to manufacture engines. A foundry and boiler house will be built, also machine shop 50x150 feet.

Bills have passed Congress authorizing bridges to be built across the Missouri River at Sioux City, Iowa, and Dakota County, Neb., and also across Yellowstone River, in Dawson County, Mont.

The General Electric Company have purchased five hundred acres of land in Readsboro, and the water privilege of Howe's Pond in North Adams, Mass., with the stated intention of erecting a new manufacturing plant.

Charles E. Thomas, R. P. Smith and others are the representatives of a new enterprise to secure its location in Woonsocket, R. I., if possible. The company intends to erect a two-story brick manufactory about 30x250 feet.

The Defiance Machine Works, Defiance, Ohio, are remodeling their works, and have purchased several of the most modern and improved machine tools. They expect to increase their capacity considerably during the next few months.

The Huntley Manufacturing Co. has been formed to manufacture milling and cleaning and separating machinery in Silver Creek, Chautauqua County, N. Y.; capital, $100,000, and directors, William W. Huntley and Benjamin E. Ryer, of Chicago.

Needing larger facilities, the Penn Iron and Coal Co., of Canal Dover, Ohio, is rebuilding the Dover furnace. An additional blowing engine, 750 horsepower of boilers, and three fire-brick stoves, and other minor improvements are also being built.

Mr. C. M. Giddings, who was for a number of years president and general manager of the Sioux City Engine Works, has opened an engineering office at Rockford, Ill., and will make a specialty of furnishing designs for engines of various types.

An electric railway will probably be built to Greenfield, Mass., by way of Montague City, and there is a talk of forming a home company to run a line to Millers Falls and Lake Pleasant, if the present petitioners do not feel like extending their lines.

The new boiler house for the Stanley Rule and Level Co. was designed by the Berlin Iron Bridge Co., of East Berlin, Conn. The side walls are of brick, the floors of iron and the roof of iron, covered with the Berlin Iron Bridge Company's patent anti condensation corrugated iron.

The reorganization of the Junction Iron and Steel Co., of Pittsburgh, Pa., was completed last week. Mr. H. M. Priest was elected president and general manager. The construction of large improvements to the works of the company are well under way, and an early improvement in the general iron and steel trades is expected.

The West Charleston (W. Va.) Street Railway Company propose to build a line to start from Two Mile Creek, below Charleston, and run east through the city to Wilson's Hollow on the east side of the city. Among the incorporators are Geo. S. Laidley, Malcolm Jackson, Geo. S. Couch, Peter Silman, Fred. P. Grosscup and J. W. Rocke.

The Cleveland Steel Range Company, of Cleveland, Ohio, will construct a brick factory, to be located on the corner of Detroit and State streets. The new building will be 50 feet wide, 192 feet long, and will be three stories high. The building will be fitted with modern machinery. The estimated cost of the structure will be from $15,000 to $20,000.

Chairman H. C. Frick has given up attention to the details of the Carnegie Co.'s business. James Gailey, of the Edgar Thomson Works, of Braddock, Pa., will enter the general offices at Pittsburgh as assistant to President John G. A. Leishman. Thos. Morrison, superintendent of the company's plant at Duquesne, will succeed Mr. Gailey at Braddock, and H. B. Miller, now master mechanic at Duquesne, will hereafter fill Mr. Morrison's position

Hill, Clarke & Co., of Boston, Mass., report great activity in the machinery line amongst bicycle manufacturers, and exceedingly satisfactory business with them and some other special lines of trade. During December and January business was so good that they say they would not wish for any increase if they could do that amount steadily throughout the year. On the other hand, sales to the general run of machine shops and manufacturers have been very light.

The buildings for the new tin-plate-mill, which will be run by the Crescent Sheet and Tin-plate Company, of Cleveland, Ohio, will be completed by the middle of April. The mill will be located on Bessemer avenue; it will cost upwards of $150,000. The building to be known as the hot-mill will be 175x75 feet in dimensions, and will be all steel. It will contain two engines, whose cylinders will be 34x72 inches, and which will have 50 ton drive wheels. There will be a 10-ton electric crane and other machinery, including a powerful dynamo. The tin house will also be of steel construction, and will be located at the end of the hot-mill. It will be 105x168 feet in dimensions, with a wing 48x48 feet. The tin house will be provided with ten tinning stacks. The annealing house, with its pickling machines and other attachments, will be still another feature of the establishment.

Machinists' Supplies and Iron.

New York, March 2, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10.25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10.25 to $10.75 for No 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—The market is quiet, prices are steady. We quote L. X., 8¼c. to 8¾c.; Cookson's, 8¾c. to 8⅞c.; Hallett's, 7.25c. to 7.30c.; and U. S. French Star, 8c.

Lard Oil—Prime City we quote at 53c. to 55c.

Copper—The market is dull, and prices are lower. Producers are more willing to meet the views of the buyers, and some business has been done at 9⅝c. for Lake Copper, and 9¼c for forward deliveries. Casting Copper is quoted at 9¼c. to 9.15c.

Lead—The market is inactive; there have been some forced sales, causing the prices to fall to 3.07½c. Moderate quantities have been sold at 3.07½c. to 3.10c.

Spelter—There is no change in the volume of business, and the market remains dull. Spot stock may yet be secured at 3.10c., but quotations are generally from 3.15c. to 3.20c.

Tin—The market is weak, with a steady decline of prices, probably due to excessive supplies. Spot sold at 13.02½c. to 13.05c., futures at 12.95c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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Wanted situation as molder; loam, dry, or green sand; best refs. R. M., American Machinist.

Draftsman, mech. knowledge of machine design, 4 yrs. exp., tech. education. Box 115, Am. Mach.

Technical graduate wants position as draftsman. Address Box 118, care American Machinist.

Position wanted by a foundry foreman of 10 yrs. exp.; good recom. if required. Mac, Am. Mach.

Draftsman, 5 yrs. practical exp., tech education, shop exp., desires change. Box 123, Am. Machinist.

Position wanted by a first-class machinist draftsman and a thorough mechanic; experienced as foreman and superintendent. Box 125, Am. Machinist.

Wanted by a young man under 30 years of age position as foreman of boiler shop; best of references. Address John McCathron, Oswego, N. Y.

Patternmaker wants situation; all round man; experienced all class machine and engine; capable as foreman. Address S. R., American Machinist.

Experienced brass foundry foreman, desirous of making a change, would like to correspond with parties requiring the services of a competent man. Address Z., Z., Z., care of American Machinist.

(*Continued on Page* 193.)

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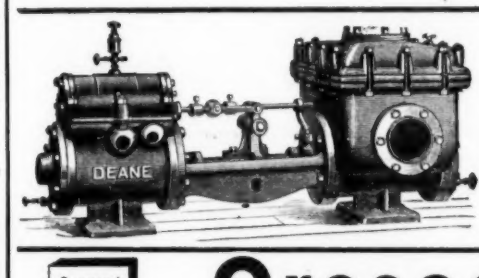

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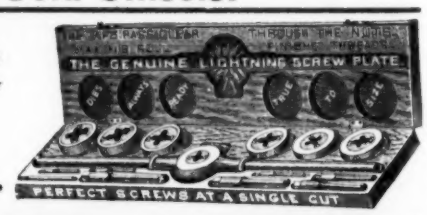

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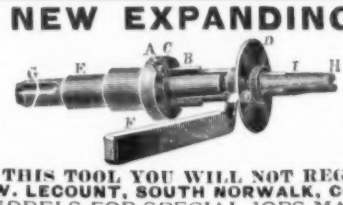

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4 (with screws)	2 " 3 "	32
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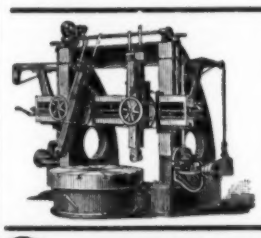

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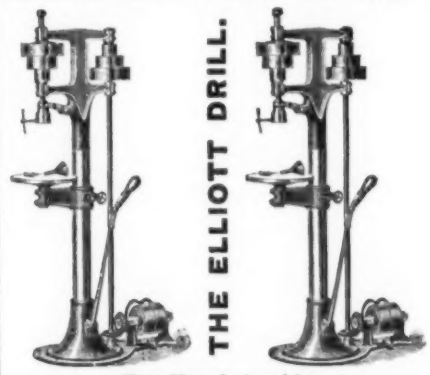

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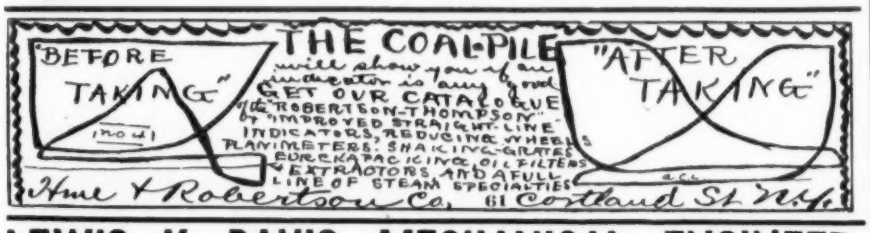
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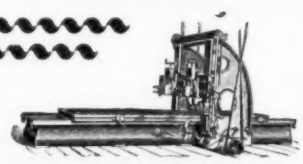

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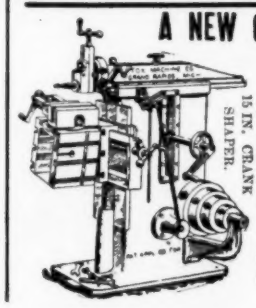

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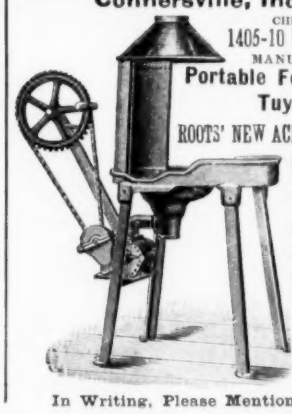

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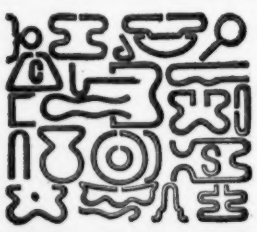

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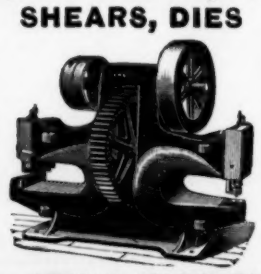
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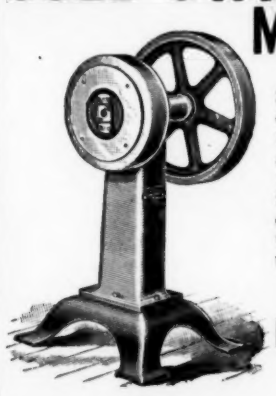

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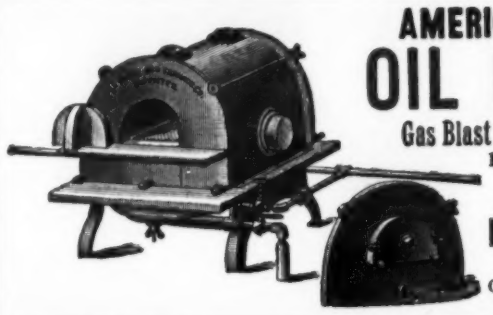

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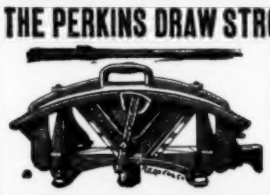

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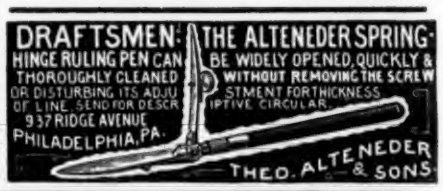

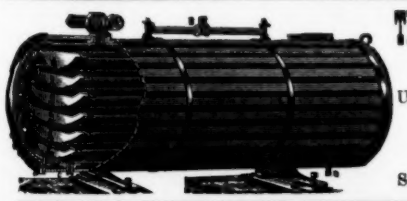

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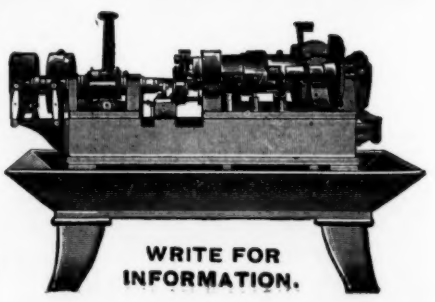

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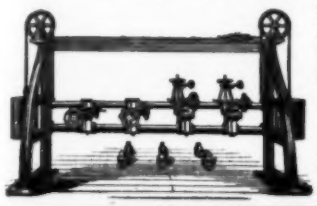

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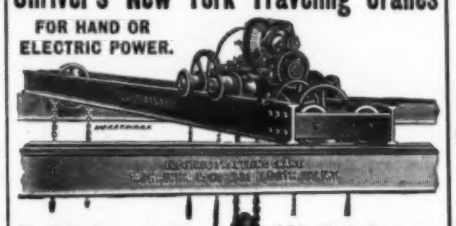

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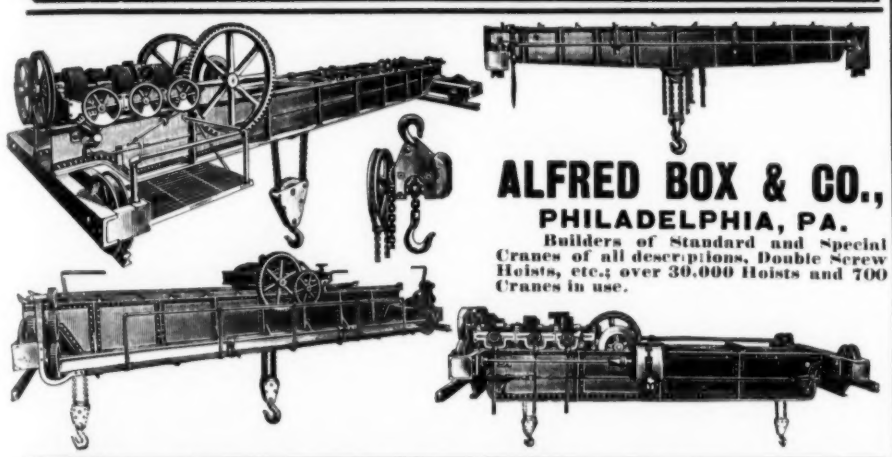

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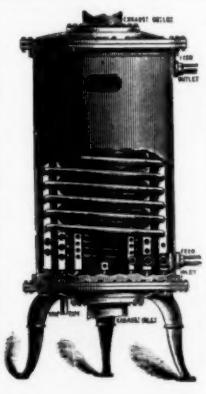

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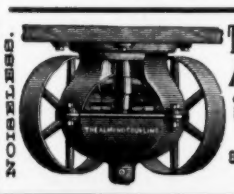

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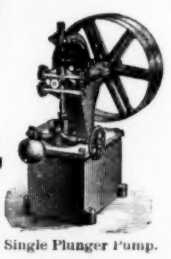

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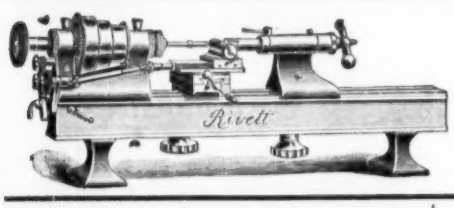

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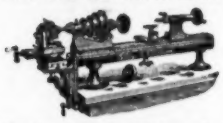

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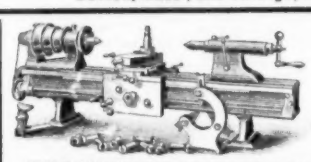

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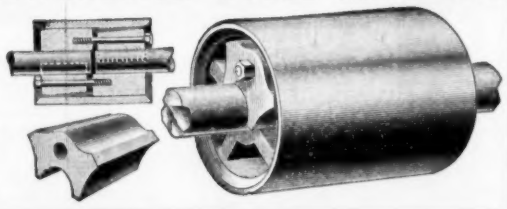

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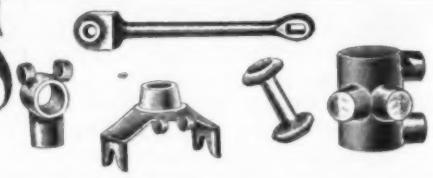

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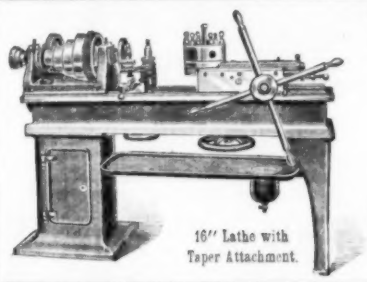

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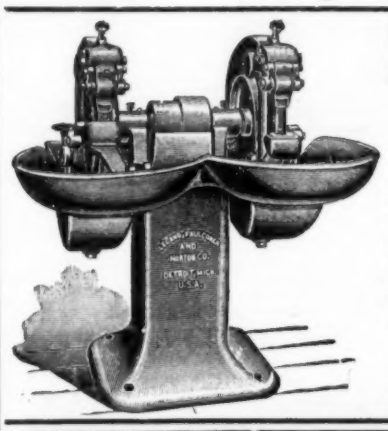

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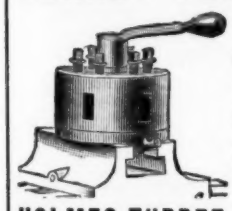

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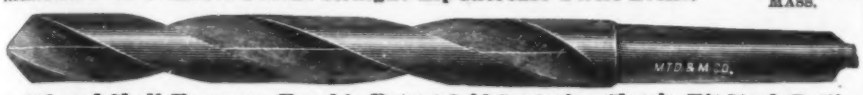

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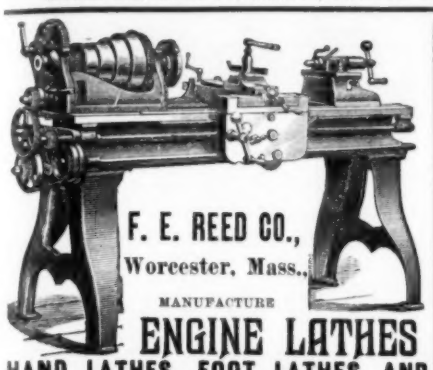

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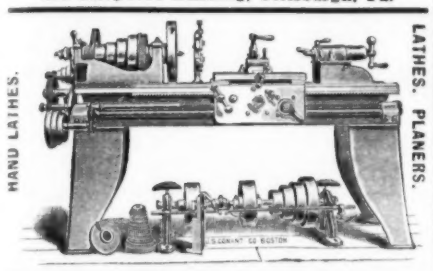

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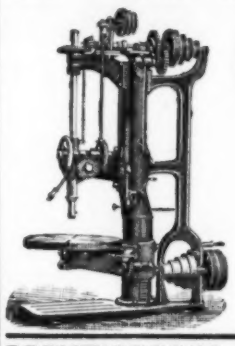

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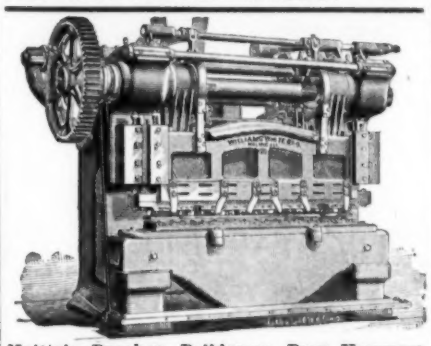

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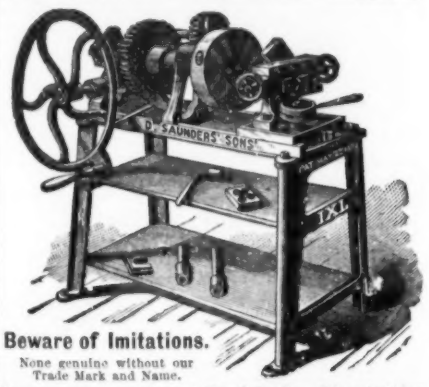

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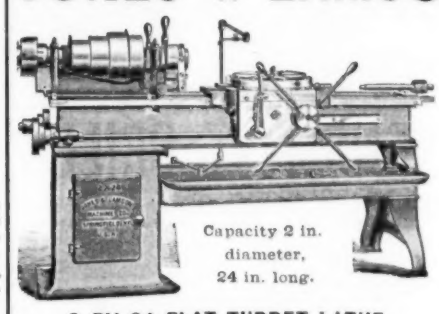

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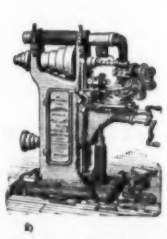

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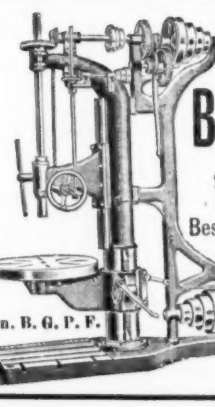

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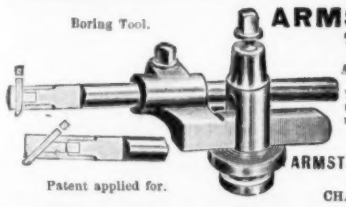

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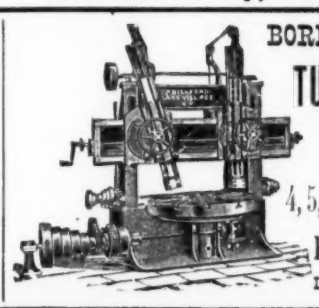

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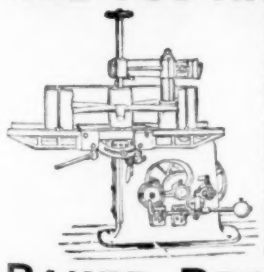

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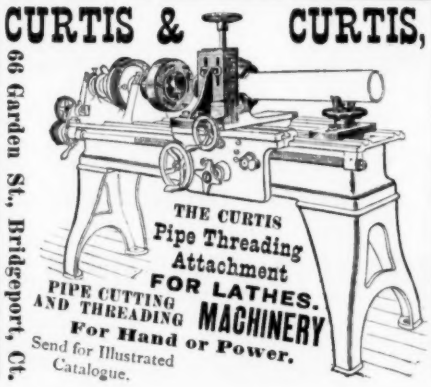

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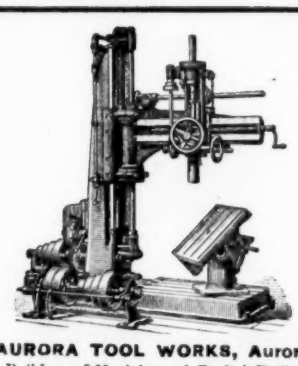

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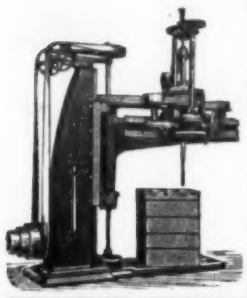

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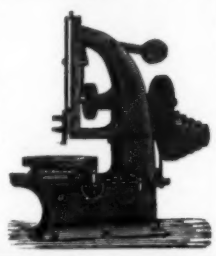

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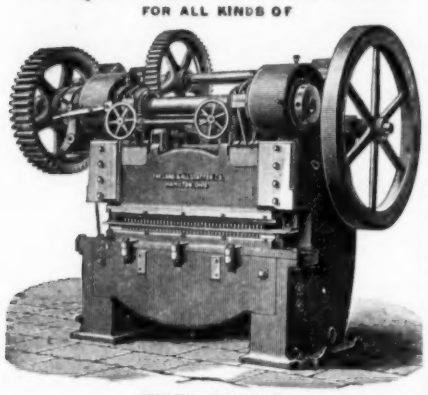

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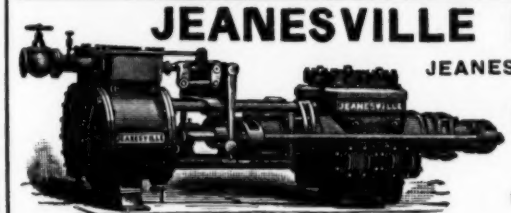

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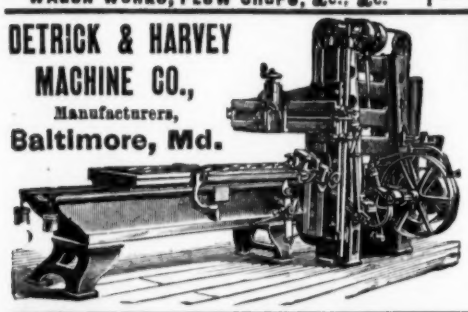

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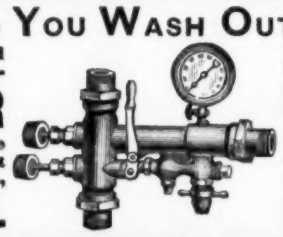

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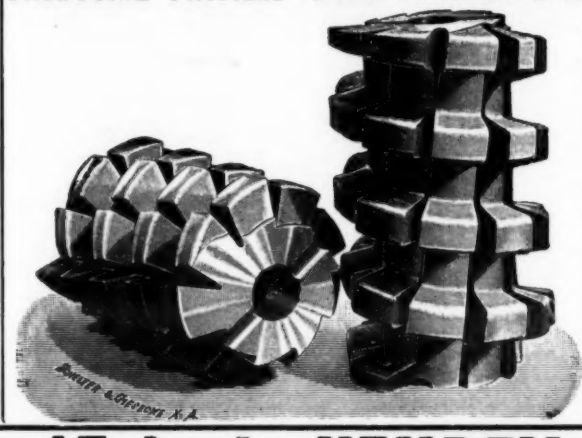

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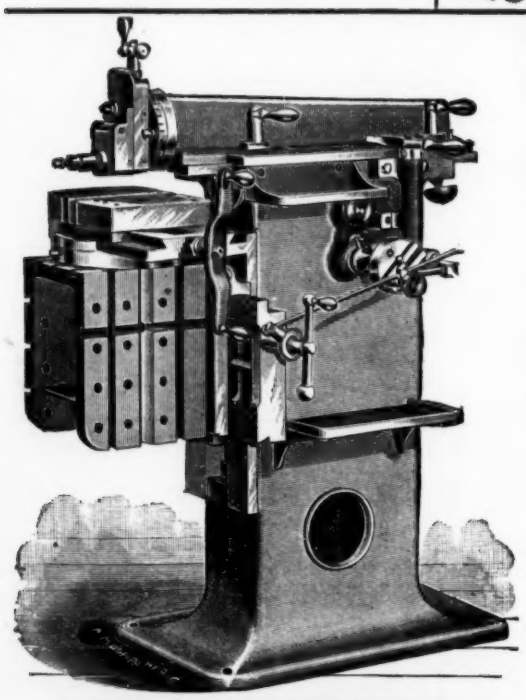

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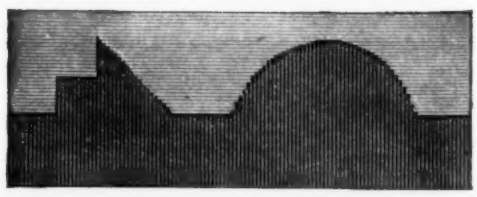

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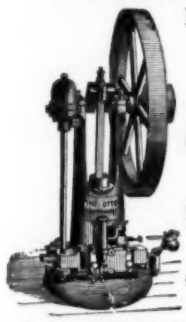

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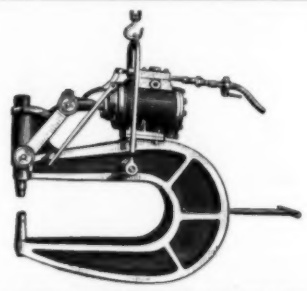

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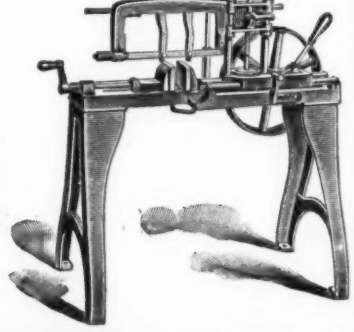

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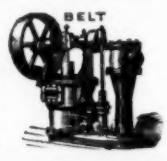

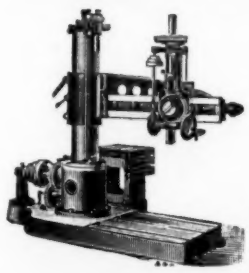

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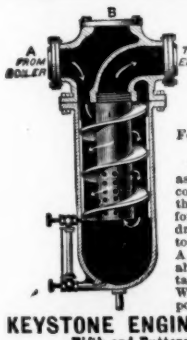

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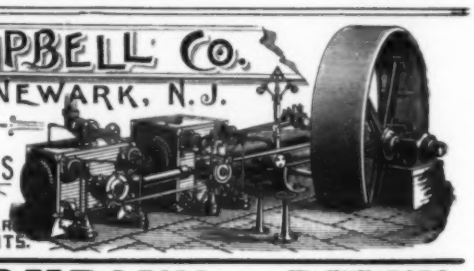

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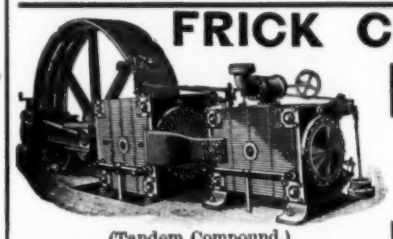

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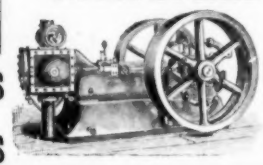

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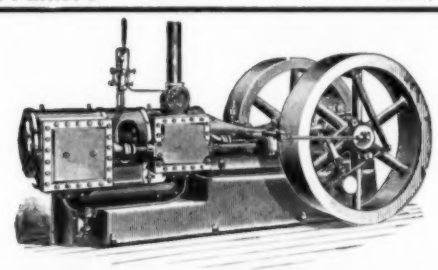

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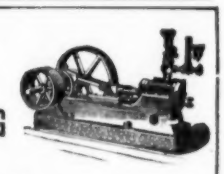

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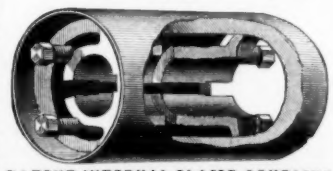

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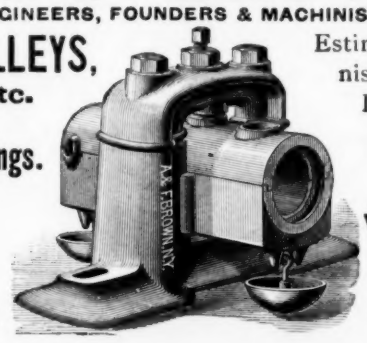

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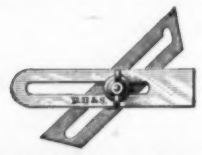

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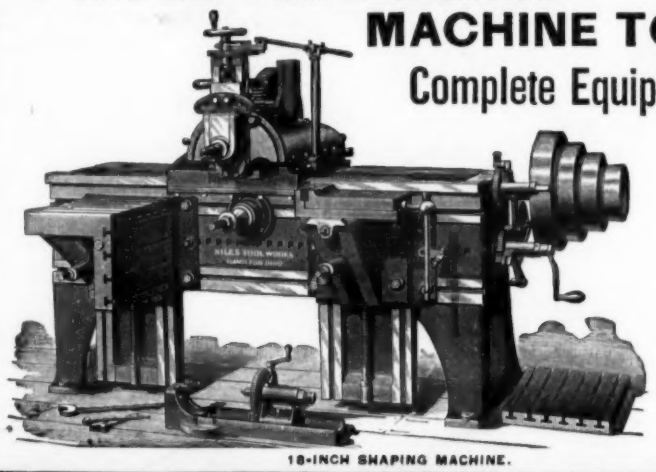

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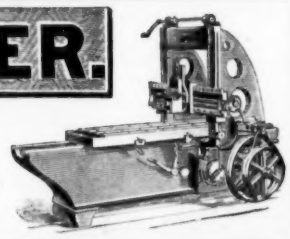

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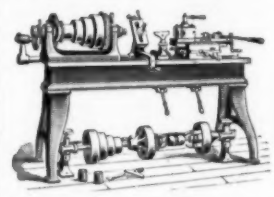

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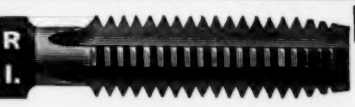

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